Engineering Library

The Engineer.

JUN 19 1929

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VOL. CXLVII.—No. 3830] LONDON: FRIDAY EVENING, JUNE 7, 1929 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere road, Lambeth, London, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—42 CRANK AXLES for LOCOMOTIVES.
SCHEDULE 2.—300 STEEL AXLES for CARRIAGES and WAGONS.
SCHEDULE 3.—346 STEEL TYRES for LOCOMOTIVES.
SCHEDULE 4.—BUFFERS, DRAWBARS, WHEELS and AXLES, and other DUPLICATE PARTS for LOCOMOTIVES.
SCHEDULE 5.—SLUICE GATES, VERTICAL SLIDING and RADIAL TYPES, for the Lloyd Barrage.

Tenders due as follows :—
Schedule 1, 14th June, 1929.
Schedule 2, 21st June, 1929.
Schedule 3, 25th June, 1929.
Schedule 4, 28th June, 1929.
Schedule 5, 17th July, 1929.

Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each Schedule. 2158

Assistant Civil Engineers REQUIRED in Works and Buildings Department of Air Ministry. Age from 25 years but not beyond 32 years 1st June, 1929. Salary £250-15-£450 plus Civil Service bonus (aggregate salary at present £361-£609). Preference ex-Service men. Candidates require to be Corporate Members of either Institution of Civil Engineers, Royal Institute of British Architects, Institution of Municipal and County Engineers, or holders of Degree in Engineering (or qualified to become Corporate Members on reaching prescribed age), with at least 2 years' experience on important works. Selected candidates will be appointed to non-pensionable posts, but opportunities to compete for pensionable posts will probably arise.—Application forms obtainable, SECRETARY, Air Ministry (W.B. 5), Kingsway, W.C. 2. 2098

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/1561.—ENGINEER REQUIRED by the GOVERNMENT of PALESTINE, for appointment as CHIEF ASSISTANT ENGINEER for the Haifa Harbour Works Department for three years' service. Salary £1200 to £1500 a year, according to experience and qualifications. Free quarters and passages. Candidates, aged 35 to 45, must be fully qualified Civil Engineers, and have had extensive experience on large Public Works, preferably on Harbour Construction, involving Quarrying.

M/1539.—ENGINEER REQUIRED by the GOVERNMENT of HONG KONG for the Public Works Department for three years' service with possible permanency. Salary £460, rising to £500 a year by annual increments of £20, and thereafter, if the appointment becomes permanent, rising by annual increments to a maximum of £1000 a year, payable in dollars under the compensation scheme at present in force at a favourable rate of exchange. Free first-class passages provided. Candidates, 25 to 30 years of age, single, must have passed Examinations for Sections A and B of the A.M.I.C.E. Diplomas or hold professional qualifications accepted by the Institution of Civil Engineers as exempting from those examinations. Must be good Draughtsman and be proficient in Land Surveying and Levelling. Should have had experience in Waterworks, Maintenance, and Administration Work of a large city, including House Services, Meterage, Mains, Waste Prevention, and General Distribution, and the Preparation of Plans, Specifications and Estimates for Waterworks Construction, such as Storage and Service Reservoirs, Filter Beds, &c.

M/1424.—SENIOR ASSISTANT ENGINEER REQUIRED by the GOVERNMENT of TANGANYIKA TERRITORY, for Road Construction in the Public Works Department, for a tour of 20 to 30 months' service, with possible extension. Salary, £720, rising to £840 a year by annual increments of £30, and thence to £920 a year by annual increments of £40. (The question will be considered of paying a higher commencing salary than £720 a year in the foregoing scale to a very highly qualified candidate.) Free quarters and passages, and liberal leave on full salary. The selected candidate will be required to provide himself with a motor car, for which a mileage allowance will be granted whilst used on duty. Candidates, 30 to 40 years of age, preferably Associate Members of the Institution of Civil Engineers, must have had previous experience as Contractors' Engineers or similar position on Road or Railway Construction abroad; must be competent to handle subordinate staff and labour; and to arrange contracts; have had experience in Survey Work and the Design of Bridges, and be competent to Take Complete Charge as Resident Engineer of Road Construction, including Earthworks, Steel, Reinforced Concrete, Timber Bridges, and auxiliary works.

M/1569.—ASSISTANT DISTRICT ENGINEER REQUIRED by the GOVERNMENT of CEYLON, for the Railway Department, for three years' service with possible extension. Salary £450, rising to £690 a year by annual increments of £30. Candidates, preferably unmarried, between the ages of 26 and 31, should have passed Sections A and B of the Examinations for the A.M.I.C.E. Diploma or hold professional qualifications recognised by the Institution of Civil Engineers as exempting from these examinations. Should have had at least three years' suitable experience on Railway Construction or on Maintenance Work. Must be capable of assisting a District Engineer in charge of a district of about 200 miles, carrying on any or all the duties of the District Engineer if and as required. Should be capable of Designing Bridges, Buildings and other structures, with all calculations necessary for these works.

M/1562.—MECHANICAL ENGINEER REQUIRED by the GOVERNMENT of PALESTINE, for appointment as Plant Engineer, Haifa Harbour Works, for three years. Salary £P800, rising to £P900 by annual increments of £P50. Free quarters or allowance in lieu and free passages. Candidates should be under 45 years of age, and Corporate Members of the Institution of Mechanical Engineers. They must have had a wide experience in the Purchase and Operation of Plant on large Public Works Contracts.

M/1376.—ASSISTANT ENGINEER REQUIRED by the RAILWAY DEPARTMENT of the FEDERATED MALAY STATES GOVERNMENT, for four years' service, with possible extension. Salary 400 dollars, rising to 475 dollars a month by annual increments of 25 dollars a month, and thereafter, in the event of the officer being retained, rising to 800 dollars a month plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. If at the end of four years' service the officers' services have been continuously satisfactory and he does not remain in the service, he will be paid a bonus of 2850 dollars. The exchange value of the dollar in sterling is at present

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The Engineer

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fixed by the Government at 2s. 4d., but the purchasing power of the dollar in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax is at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 30, preferably unmarried, must have received a good theoretical training, preferably at a University or a College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree, or obtained such other diploma or distinction in Engineering as the Secretary of State may decide in any particular case, or completed their articles with a Civil Engineers of good standing, and have passed the Examination for Associate Membership of the Institution of Civil Engineers. Should have had at least one year's practical experience of Railway Maintenance, including Bridge Design and Erection on a British Railway.

M/1502.—ASSISTANT ENGINEER REQUIRED for the PUBLIC WORKS DEPARTMENT of the STRAITS SETTLEMENTS, for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory, and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Straits Settlements Government. Free passages provided. Candidates, age 23 to 26, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtain such other diploma or distinction in Engineering as the Secretary of State may decide in any particular case, or have completed articles with a Civil Engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of Civil Engineering under a qualified Civil Engineer.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 2134

PUBLIC NOTICES

MANCHESTER MUNICIPAL
COLLEGE OF TECHNOLOGY.
Principal :
B. MOUAT JONES, D.S.O., M.A. (Oxon).

UNIVERSITY OF MANCHESTER.
(FACULTY OF TECHNOLOGY).
DEGREE COURSES IN TECHNOLOGY.

The Prospectus gives particulars of the courses leading to the Manchester University Degrees (B.Sc. Tech., M.Sc. Tech., and Ph.D.), and Certificates in the Faculty of Technology, in the following Departments :—

MECHANICAL ENGINEERING
(Prof. Dempster Smith, M.B.E., M.Sc. Tech., M.I.M.E.).
ELECTRICAL ENGINEERING
(Prof. Miles Walker, M.A., D.Sc., M.I.E.E.).
MUNICIPAL AND SANITARY EGINEERING
(G. S. Coleman, D.Sc. Eng., A.M. Inst. C.E., A.M. Inst. M. and Cy. E., F.R. San. I.).
APPLIED CHEMISTRY, including General Chemical Technology, Chemistry of Textiles (Bleaching, Dyeing, Printing and Finishing), Paper Manufacture, Metallurgy and Assaying, Chemical Technology of Brewing, Electro-chemistry, Photography, Colouring Matters, Foodstuffs, and Fuels
(Prof. James Kenner, D.Sc., Ph.D., F.R.S.).
TEXTILE TECHNOLOGY
(Professor W. E. Morton, M.Sc. Tech.).
INDUSTRIAL ADMINISTRATION (Post-Graduate Certificate Course)
(J. A. Bowie, M.A., D.Litt.).

Prospectus will be forwarded free on application to the REGISTRAR, College of Technology, Manchester. 2089

Northampton Polytechnic INSTITUTE,
ST. JOHN-STREET, LONDON, E.C. 1.

FULL-TIME COURSES IN ENGINEERING are provided as follows :—
MECHANICAL.
CIVIL.
AERONAUTICAL.
ELECTRICAL AND
ELECTRICAL COMMUNICATION.

Students are able to qualify for the Polytechnic Diploma and (if matriculated) the Engineering Degree of London University.

For prospectus giving particulars as to fees, &c., apply to
2099 THE PRINCIPAL.

PUBLIC NOTICES

University of Durham.
ARMSTRONG COLLEGE,
NEWCASTLE-UPON-TYNE.
LECTURESHIP IN MECHANICAL ENGINEERING.

The Council of Armstrong College invites APPLICATIONS for a LECTURESHIP in MECHANICAL ENGINEERING. Salary £300 to £400, according to qualifications. Candidates must have had practical experience. Duties to commence on 1st October, 1929. Ten copies of applications and of not more than three testimonials should be lodged, not later than Saturday, 22nd June, 1929, with the undersigned, from whom further particulars may be obtained.
J. Y. T. GREIG,
Registrar,
2070 Armstrong College.

City of Hull Water and Gas DEPARTMENT.
SPRINGHEAD PUMPING STATION.

The Corporation are prepared to receive TENDERS for the SUPPLY and ERECTION of ONE SET of ENGINE and PUMPS, complete, for the Suburban High Level District.

Copies of specification and form of Tender, together with drawings of the buildings, may be obtained of the undersigned on payment of £2, which will be returned on receipt of a bona fide Tender.

Cheques and postal orders to be made payable to F. Steadman, Esq., City Treasurer.

Sealed Tenders, endorsed "Pumping Plant, Springhead," are to be addressed to the Chairman of the Water and Gas Committee, and delivered at the Town Clerk's office not later than Saturday, the 29th June, 1929.

The Corporation do not bind themselves to accept the lowest or any Tender.
By Order,
W. D. BINGHAM,
City Water Engineer.
Alfred Gelder-street, Hull,
June, 1929. 2129

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 5th July, TENDERS for the SUPPLY of :—
1. TANK WAGONS ;
and up to Noon on Friday, 28th June, TENDERS for the SUPPLY of :—
2. STEEL MATERIAL (Plates, Channels, Angles, Rounds, &c.).
3. STEEL AXLES for WAGONS.
4. STEEL TYRES for WAGONS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of £1 each for No. 1 and 10s. each for Nos. 2, 3 and 4 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG,
Secretary.
Offices, The White Mansion,
91, Petty France, Westminster, S.W. 1,
5th June, 1929. 2137

County of London.
TO MANUFACTURERS OF ELECTRIC TRAMCAR BODIES, TRUCKS AND ELECTRICAL EQUIPMENTS, &c.

The London County Council invites TENDERS for the MANUFACTURE, SUPPLY, DELIVERY and MAINTENANCE of :—
" A."—150 COMPLETE BODIES for ELECTRIC TRAMCARS.
" B."—150 COMPLETE SETS of SWING BOLSTER BOGIE TRUCKS for ELECTRIC TRAMCARS.
" C."—150 COMPLETE SETS of ELECTRICAL EQUIPMENTS for TRAMCARS, together with the ASSEMBLY of 150 CAR BODIES, SETS of TRUCKS, ELECTRICAL EQUIPMENTS and MAGNETIC BRAKES into Complete Tramcars, and their Final Preparation for Service use.
" D."—150 COMPLETE SETS of MAGNETIC TRACK and WHEEL BRAKE EQUIPMENTS for BOGIE TRAMCARS.

Specifications, forms of Tender, and other particulars may be obtained on application to the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, on or after Noon on Monday, 17th June, 1929, upon payment to the Cashier of the Council of a fee of £2 each for the documents covering either " A," " B," " C," or " D," or £7 for the four sets complete. The fee will be returned to each tenderer, provided he shall have submitted a bona fide Tender and shall not have withdrawn same.

General particulars of the work may be obtained on application at the County Hall, previously to the payment of any fees for specifications, &c.

Drawings and samples as referred to in the specifications can be inspected by appointment with the General Manager of Tramways, 23, Belvedere-road, Lambeth, S.E. 1, on production of either a copy of the specification concerned or a signed receipt for the fee paid in respect thereof.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

Each Tender must be submitted upon the respective official form and with its accompanying documents enclosed in a sealed cover addressed to the Clerk of the Council. No Tender received at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 8th July, 1929, will be considered. The Council does not in any case bind itself to accept the lowest or any Tender.
MONTAGU H. COX,
2096 Clerk of the London County Council.

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PUBLIC NOTICES

Bombay Port Trust.

The Trustees of the Port of Bombay have for SALE the Self-propelling Ladder DREDGER "OCTOPUS," with a designed capacity of 1000 tons hour, and the TWO Self-propelling steam DEP BARGES "GULL" and "HERON," with a carrying capacity of 1000 tons.

These vessels were built as a dredging unit for Bombay Port Trust by Messrs. Wm. Simons and Ltd., Renfrew, Scotland, in 1904. They are now in Bombay and are surplus to the requirements of the Port.

The vessels are of the following dimensions :—

	Octopus.	Gull.	Heron.
Length between perpendiculars	192ft.	190ft.	190ft.
Breadth moulded	36ft.	30ft.	30ft.
Depth moulded	13ft.	15ft. 9in.	15ft. 9in
Dredging depth	44ft.	—	—
Designed speed in knots	8	10	10
Gross tonnage	661	780	783
Nominal Horse-power	132	108	108
Screws	Twin	Twin	Twin

For further particulars, apply to the CONSULTING ENGINEERS and AGENTS, Bombay Port Trust, 2, Queen Anne's-gate, Westminster, S.W. 1, and for an opportunity to inspect the vessels, apply to the Chief Engineer, Bombay Port Trust, Ballard-road, Bombay. 2155

Metropolitan Water Board.

TENDERS FOR THE SUPPLY OF STORES.

The Metropolitan Water Board invite TENDERS for the SUPPLY of the undermentioned STORES, &c., for the periods of 6 and 12 months, commencing 1st August, 1929 :—

Tender No.

2.—Brushes, Brooms and Handles.
5.—Cotton Waste, Engine Wipers, Cleaning Cloth, &c.
6.—Hemp, Yarn, Rope, House Flannel, &c.
10.—Lead, Zinc and Glass.
13.—Oilman's Sundries, Soaps, Tar, Gas Mantles, Metal Polish, &c.
14.—Packings, Rubber Goods, Hose and Leather Belting, &c.
15.—Paints, Varnishes, Linseed Oil, Turpentine, &c.
18.—Scrap Iron—Purchase and Removal of.
24.—Electric Lamps.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer, by personal application, at the offices of the Board (Room 155), or upon forwarding a stamped addressed sack envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board" and endorsed in the manner indicated in the form of Tender, must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Wednesday, 19th June, 1929.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
4th June, 1929. 2132

The Madras and Southern

MAHRATTA RAILWAY COMPANY, Limited, invite TENDERS for :—

(1) 6324 STEEL BOILER TUBES.
(2) 24 FOUR-WHEELED PETROL TANK WAGONS, BROAD GAUGE (12 with WHEELS and AXLES and 12 without WHEELS and AXLES).
2 BOGIE PETROL TANK WAGONS, METRE GAUGE (without WHEELS and AXLES).

Tenders for (1) are due in on Tuesday, 25th June, and for (2) on Tuesday, 2nd July, 1929, by 2 p.m.

Tender forms obtainable at the Company's Office ; fee One Guinea each, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Office :
25, Buckingham Palace-road,
Westminster, S.W. 1. 2135

West Midlands Joint Electricity Authority.

IRONBRIDGE POWER STATION.

TENDERS are INVITED by the above-named Authority for the SUPPLY, DELIVERY, and ERECTION at their Ironbridge Power Station of a complete BOILER HOUSE EQUIPMENT, which will include :—

Three Boilers, each having a normal rating of 225,000 lb. of steam per hour, together with Economisers, Air Heaters, Fans, Pipe Work, Coal Pulverising Plant, Ash-handling Plant, &c.

Copies of specification (No. 3) and form of Tender may be obtained from Mr. E. F. Hetherington, M.I.E.E., M.I. Mech. E., Chief Engineer and Manager, at the offices of the Authority, on payment of a deposit of Two Guineas, which will, after the Authority have come to a decision upon the Tenders received, but not before, be returned to the tenderer, provided he shall have sent in a bona fide Tender and shall not have withdrawn it. Additional copies of the specification may be obtained on payment of One Guinea per copy, which will not be returned.

Tenders must be forwarded under sealed cover, endorsed "Tender for Contract No. 3—Ironbridge Power Station," so as to reach the undersigned not later than Noon on Wednesday, the 10th July, 1929.

Tenders will not be considered for individual sections of the plant, and the Authority do not bind themselves to accept the lowest or any Tender.

H. F. CARPENTER,
Clerk and Treasurer.

Offices of the Authority :
Phœnix Buildings,
Dudley-road, Wolverhampton,
3rd June, 1929. 2110

County Borough of Brighton.

WATERWORKS DEPARTMENT.
DRAUGHTSMAN.

APPLICATIONS are INVITED for the APPOINTMENT of a DRAUGHTSMAN in the above Department, at a commencing salary of £4 per week.

Candidates should not be more than 35 years of age and must be neat and expeditious Draughtsmen and good Surveyors and Levellers. Previous experience in a Waterworks Engineer's Office is necessary, and candidates should possess a sound knowledge of Building Construction, Service Reservoir Design, and Pipework. Other things being equal, preference will be given to persons who have passed Sections A and B of the Associate Membership Examination of the Institution of Civil Engineers.

Applications, stating age, qualifications and experience, accompanied by copies of not more than three recent testimonials, and endorsed "Draughtsman," should be addressed to me and delivered at my office not later than Wednesday, the 19th inst.

A. B. CATHCART, M. Inst., C.E.,
Waterworks Engineer.

12, Bond-street, Brighton,
5th June, 1929. 2142

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED for Calcutta, Thoroughly Capable ASSISTANT for Engineering and Repair Workshops. State age and give full particulars of training and experience ; medical examination necessary ; five years' engagement. Preference given to North countryman or Scot.—Apply, with fullest details, to JOHN SHAW and SONS (WOLVERHAMPTON), Limited, Wolverhampton. 2071 A

ASSISTANT ENGINEER REQUIRED by Large Provincial Omnibus Undertaking ; preferably with theoretical qualification as well as practical experience. Commencing salary £300-£350 p.a.—Address, 2141, The Engineer Office. 2141 A

ASSISTANT MANAGER WANTED for Shipyard and Engineering Works in China. Age about 40. One who has been trained as a technical and practical engineer with knowledge of Shipbuilding, also Ship and Engine Repairs. One who is energetic and has already held a responsible or similar position preferred.—Address, stating age, detailing experience and qualifications, also salary expected, P5882, The Engineer Office. P5882 A

YARROW HOME and HOSPITAL
FOR CHILDREN
BROADSTAIRS.

For the Early & Preventive Treatment of Disease & Convalescence after illness.

In these days of high cost of living, people of limited means are sometimes placed in a difficulty when their children are ill or need operations and afterwards require a change of air and much careful attention during convalescence. It cannot be too well known that the Yarrow Home and Hospital for Children, Broadstairs, Kent, was founded specially for the children of those who are not too well endowed with this world's goods. At this Home a child recovering from illness or an operation, or needing a long course of medical or surgical treatment, receives, amid the happiest possible surroundings and companionship, careful nursing and attention, such as could ordinarily only be obtained at expensive nursing homes. There are beds for fifty boys between the ages of four and twelve years, and for fifty girls between the ages of four and fourteen years. In special cases these age limits may be exceeded by two years. The fee is one guinea per week and travelling expenses. Applications for the entrance of patients are welcomed from professional people, such as members of the Institution of Civil Engineers, architects, artists, authors, clergymen, members of the medical, legal, and other professions, members of scientific societies, officers of the Navy, Army, and Royal Air Force, officers of the merchant navy, school masters, university professors, &c. The London office is at 116, Victoria-street, Westminster, and the Secretary will be pleased to send full particulars to anyone who is interested.

COMPANY MEETING

JOHN HETHERINGTON & SONS, LTD.

INCREASED DIVIDEND.

SATISFACTORY PROGRESS IN ALL BRANCHES.

Presiding at the Annual General Meeting on the 29th ult., Mr. Martin Coles Harman, the chairman, said that net profits, after providing for depreciation, were £70,578 18s. 7d., or approximately £7000 more than the previous year. It was proposed to pay a dividend of 7½ per cent. on the Ordinary shares, being ½ per cent. more than last year, and to carry forward £33,393 14s. It was the fifth consecutive year showing an increase of profits. Many economies in production had been effected. The mainstay of the business was still the cotton, wool, worsted and waste machinery. The new Nasmith Comber was very popular. The Rayon Machinery had given great satisfaction to customers. The first of the Maratti Machines was operating commercially, and giving satisfaction. They believed this machine would create a revolution in knitting. The Machine Tool business now contributed to the profits and the outlook was good.

Mr. Harman referred to the great increase in world consumption of artificial silk, the production of which was still only about 3 per cent. of that of cotton alone. Mr. Harman stated that if means could be devised for avoiding the loss of strength due to lack of co-operation among textile machinists, Hetheringtons would favourably consider any proposals from within that industry.

In closing, reference was made to the excellent work of Mr. E. V. Haigh (managing director) and his supporters of every grade. Mr. Haigh said that the decisive factor in the company's emergence from the difficulties which followed the last boom had been the chairman's leadership. He praised the staff for their unstinted efforts throughout the period of concentration and re-organisation ; shareholders could feel that the spirit of enterprise which animated the whole staff could encourage them to look forward to the company's prosperity and expansion. 2156

SITUATIONS OPEN (continued)

ASSISTANT to HEAD ENGINEER REQUIRED in the Electrical Department at a group of Collieries, including Coking and By-product Plants. Applicant must possess good technical training, be conversant with costs and estimates and should give full particulars of training. State age and salary required.
Address, 2151, The Engineer Office. 2151 A

ASSISTANT WORKS MANAGER REQUIRED for a works manufacturing H.T. Switchgear. Experience in modern workshop practice, tool design and manufacture, planning, rate fixing and up-to-date machine processes, Manchester district. Successful applicant must have initiative and be capable in control of labour. Knowledge of electrical gear an advantage, but not essential. State in confidence age, experience, references, and salary required.—Address, 2105, The Engineer Office. 2105 A

D. NAPIER and SON, Ltd., and REDUCED, Acton Vale, London, W. 3, REQUIRE experienced ENGINEER, to Take Charge of Jig and Tool Design and Tool Production ; also experienced CHIEF RATE FIXER.

Applicants for either appointment must have held a similar position and been used to very high-class production.

Applications, giving full details of experience, in date order, age and salary required, should be addressed to LABOUR OFFICER. 2120 A

IMPORTANT GROUP, Not Acquainted with or Connected with electric cable making in England, are anxious to OBTAIN the ADVICE and ASSISTANCE of an ENGINEERING MANAGER capable of advising upon the technology of the manufacture of Power and Lighting Cables.

Applicant must be competent to equip and start up a factory.
Address, P5876, The Engineer Office. P5876 A

MANAGER REQUIRED for London Sales Office and Warehouse handling special alloys ; must be sound engineer with knowledge of Chemistry ; first-class education and address essential ; progressive appointment for first-class man who can interview top people.—Address, 2023, The Engineer Office. 2023 A

REQUIRED for the East, First-class GENERAL HARDWARE SALESMAN, 24/29, single, preferably one trained in first-class London Firm of General Hardware, Engineers' Stores, Tools and Builders' Ironmongery Merchants ; must be capable of developing sales inside and by travelling. Only single men similarly employed, of good general selling ability and education, will be considered. Good salary for suitable man, passage, 4 years, 6 months' half-pay leave.—Address, giving full details education, training and experience, 2090, The Engineer Office. 2090 A

SALES MANAGER REQUIRED for an Engineering Works building specialities.

Position requires a man of good education and presence, age 30 to 35, with thorough knowledge of sales investigation and office procedure.

Applicants to give full details of education, training and experience, send copies of any testimonials, also to state age and whether married or single.
Address, 2033, The Engineer Office. 2033 A

SUPERIOR METALLURGICAL CHEMIST WANTED by a first-class Firm of Wire and Cold-rolled Steel Strip Manufacturers. Must be capable of taking charge of entire laboratory and staff. Possessed of practical knowledge of this trade and experienced in research work as regards physical tests, composition, heat treatment, &c.—Written application only, which will be treated in strictest confidence, giving particulars of experience and salary required, to Dr. PERCY LONGMUIR, 2, Queen's-road, Sheffield. 2103 A

TO HEATING AND SANITARY SALES SPECIALISTS.—SEVERAL VACANCIES occur with progressive firm. Applicants must have thorough modern technical knowledge of above subjects, with connections amongst consulting engineers and architects. Personality and address essential. No applications will have any consideration unless the following information is given :—Age ; last ten years' experience in detail ; why wishful to transfer services ; salary now received and expectations. All applications absolutely confidential.—Address replies, Managing Director (Personal), CRANE-BENNETT, Ltd., 45/51, Leman-street, London, E.1. 2128 A

SITUATIONS OPEN (continued)

WANTED AT ONCE, Competent DRAUGHTSMAN, for design of Coal and Coke-handling Machinery. Give full particulars of age and experience.—Address, 2159, The Engineer Office. 2159 A

WANTED AT ONCE, JUNIOR ENGINE DRAUGHTSMEN.—Write, stating experience, age, salary required, and when at liberty, &c., to A.D.C. AIRCRAFT, Ltd., Purley Way, Waddon, Croydon. 2108 A

WANTED, CHIEF DRAUGHTSMAN, Take Charge Drawing-office. Must have manufacturing and designing experience ; one experienced in Underground Conveyor Manufacture preferred. State experience, qualifications, and salary required.—Address, 2126, The Engineer Office. 2126 A

WANTED, DRAUGHTSMAN, with General Engineering experience.—Address, stating experience, age, and salary required, 2149, The Engineer Office. 2149 A

WANTED for Doncaster District, Young Temporary DRAUGHTSMAN, preferably with some experience with Elevators, Conveyors and Screening Machinery. State age, full particulars and salary required.—Address, 2088, The Engineer Office. 2088 A

WANTED, JUNIOR and SENIOR DRAUGHTSMEN, used to designing and detailing Steel Buildings, by Consulting Engineers in Westminster. —Address, stating qualifications, salary, &c., 2148, The Engineer Office. 2148 A

AIRCRAFT DRAUGHTSMAN, Knowledge Aircraft Instruments, also capable to undertake buying.—Write full details of experience, age, and salary required to A.D.C. AIRCRAFT, Ltd., Purley Way, Waddon, near Croydon. 2122 A

CHIEF DRAUGHTSMAN WANTED for Marine Engine and Boiler Works on North-East Coast. State age, experience, and salary required.—Address, 2125, The Engineer Office. 2125 A

DRAUGHTSMAN and ESTIMATOR, Experienced in designing Hot Water and other Warming Plants for buildings. Good opportunity for suitable man. —Write, stating age, experience, and salary required, to HOPE'S HEATING and LIGHTING, Ltd., 59, Berners-street, London, W. 1. 2150 A

DRAUGHTSMAN DESIGNER, Experienced, for Commercial Vehicle and 'Bus Chassis Layout and Design of Components. Permanency, near London. Age, experience, and salary.—Address, 2093, The Engineer Office. 2093 A

DRAUGHTSMAN.—For London, Good Capable DRAUGHTSMAN WANTED for arrangement and details of Oil Refinery Work. Previous experience preferred. State age, wage, and experience.—Address, P5880, The Engineer Office. P5880 A

DRAUGHTSMAN for London Office, to Detail Light Structural Steel Work, &c. Knowledge Bunker and Hopper Work, also some mechanical experience desirable, but not essential. State salary required.—Address, 2154, The Engineer Office. 2154 A

DRAUGHTSMAN, Junior, for London Office ; knowledge of Structural Steel Work design essential. State age, experience, and salary required.—Address, 2157, The Engineer Office. 2157 A

DRAUGHTSMAN, Mechanical, with Experience of Power Transformers preferred.—Apply, stating age, experience, and salary required, to MANAGER, Drawing-offices, B.T.H. Co., Ltd., Rugby. 2106 A

DRAUGHTSMAN, Mechanical-electrical, with General experience of Electrical Apparatus.—Address, stating age, experience, and salary required, 2107, The Engineer Office. 2107 A

DRAUGHTSMAN REQUIRED by Firm of Water Filtration Engineers, capable of preparing neat layout drawings. Must be neat and quick tracer.—Address, stating age, experience, and salary required, 2152, The Engineer Office. 2152 A

DRAUGHTSMAN REQUIRED, with First-class Experience in Reinforced Concrete design. State age and salary required, also give particulars of training and class of work engaged upon recently.—Address, 2104 The Engineer Office. 2104 A

DRAUGHTSMAN, W. London, Experienced General Engineering and Machine Shop Detail, practical and technical, knowledge Wrought Iron Piping essential.—Address, stating wages required and experience, 2153, The Engineer Office. 2153 A

DRAUGHTSMEN WANTED for London Works. Must have had experience with Printing Presses. Write full particulars and salary required.—Address, 2029, The Engineer Office. 2029 A

DRAUGHTSMAN WANTED, Fully Experienced in all classes of Centrifugal Pumps.—Apply, stating experience, age, married or single, and wages expected, to W. H. ALLEN, SONS and CO., Ltd., Queen's Engineering Works, Bedford. 2123 A

DRAUGHTSMAN, with Experience on Machine Tools and Jigs ; also JUNIOR or IMPROVER ; Midlands. State full experience, salary required, and age.—Address, 2092, The Engineer Office. 2092 A

DRAUGHTSMAN, with Works Experience and knowledge of Machine Tools, Jigs, &c. Wages offered 70s. to 80s. per week.—Write, with full particulars of age and experience, to GUEST and CHRIMES, Limited, Rotherham. 2124 A

ENGINEER DRAUGHTSMAN REQUIRED, with Machine Design experience and knowledge Boiler-house Practice. State all particulars. Progressive situation. Urgent.—Address, P5877, The Engineer Office. P5877 A

JUNIOR DRAUGHTSMAN WANTED, West of England district. Preference will be given to a man who has had good workshop experience in General Engineering Works. State age, references, salary.—Address, 2063, The Engineer Office. 2063 A

LIFTS.—Qualified DRAUGHTSMAN WANTED, with first-class Electrical Design and Layout experience and fully conversant with modern practice. Full particulars, experience, salary required.—Address, 2040, The Engineer Office. 2040 A

SITUATIONS OPEN (continued)

REQUIRED in London, a Capable STRUCTURAL and MECHANICAL DRAUGHTSMAN. Must be neat and accurate, and have had good experience in Chemical or similar Plant Layouts. Applicants should state age, experience, wages required, and when at liberty.—Address, 2097, The Engineer Office. 2097 A

SENIOR DRAUGHTSMAN REQUIRED in Westminster, with knowledge of Furnace Design and Combustion. Must also have had workshop experience. State age, previous career and salary required. —Address, 2030, The Engineer Office. 2030 A

SEVERAL DRAUGHTSMEN REQUIRED for the design of Oil Circuit Breakers. Previous experience in this class of work desirable, but not essential. Also SEVERAL DRAUGHTSMEN REQUIRED for Layout of High-tension and Low-tension Switchboards.—Apply, stating age, experience, and salary required, to THE GENERAL ELECTRIC CO., Ltd., Witton, Birmingham. 2147 A

STRUCTURAL STEEL WORK.—WANTED, First-class JUNIOR DRAUGHTSMAN, with good experience of Steel-frame Building Work, able to detail for fabrication from steel plans on own responsibility, must also be quite competent to take dimensions at site. State salary required.—Applications only by letter to CHIEF DRAUGHTSMAN, Smith, Walker, Ltd., 16, Caxton-street, S.W. 1. P5885 A

THREE STRUCTURAL DRAUGHTSMEN REQUIRED for detailing all classes of Light Constructional Work.—State age, experience, and salary required to BOULTON and PAUL, Ltd., Norwich. 2100 A

TOOL DRAUGHTSMAN.—Capable MAN REQUIRED, with good experience on Press Tool design, by Electrical Engineers, W. London district.—Address, stating experience, age, salary required, &c., 2130, The Engineer Office. 2130 A

TOOL DRAUGHTSMAN REQUIRED for Jigs, Auto. Tools, &c., by leading Electrical Firm, London district.—Address, stating experience, age, salary required, &c., 2131, The Engineer Office. 2131 A

TRACER (Lady) for London. Accustomed to mechanical details and plant arrangement. State wage and experience.—Address, P5881, The Engineer Office. P5881 A

WATER-TUBE BOILER MANUFACTURERS REQUIRE the SERVICES of an ASSISTANT CHIEF DRAUGHTSMAN. Only those with sound knowledge of this class work need apply.

Address in first instance, stating age, salary expected, and previous experience, 2074, The Engineer Office. 2074 A

WELL-KNOWN FIRM of Diesel Manufacturers WANT DRAUGHTSMAN, with good experience in Marine Diesel Auxiliary Plant of the enclosed type. Only thoroughly experienced men need apply. —Address, stating full particulars as to age, experience, and salary required, 2094, The Engineer Office. 2094 A

ELECTRICAL ENGINEER (FOREMAN) WANTED by Shipbuilders in Shanghai. Age about 35, total abstainer. Must have had technical training and capable of making plans. Experienced in Installation Maintenance and Fitting Out Ships, also Ship and Workshop Repairs. Three years' engagement.—Address, stating age, detailing experience and wages required, P5883, The Engineer Office. P5883 A

FOREMAN REQUIRED for Pipe Bending Department dealing with all classes of Iron and Steel Pipes for Marine Work. Should have previous experience as Foreman or Under-Foreman. State experience, age, wages expected.—Address replies, MANAGER, The Caledon S. and E. Co., Ltd., Dundee, marked "Foreman." P5871 A

SITUATIONS WANTED

WANTED by Mechanical Engineer, MANAGERIAL or ADMINISTRATIVE POSITION in established engineering firm. Willing to invest capital. Retiring director's position preferred.—Write, H., 30, Westcombe Park-road, London, S.E. P5869 B

A MECHANICAL ENGINEER and First-class DESIGNER, of proved inventive ability and with successful record, DESIRES POSITION. Wide and varied experience ; used to intricate machinery. First-class Diplomas ; well educated ; fluent French ; highest references.—Address, P5887, The Engineer Office. P5887 B

A. M.I. MECH. E., with Wide Technical, Executive and administrative experience, shortly returning from the Near East, is OPEN to CONSIDER any RESPONSIBLE POST, technical or commercial, at home or abroad. Special experience in steel works and oil works practice.—Letters to Box C.E., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 1963 B

ENGINEER (35), Sound Tech. Training and Good exper. in steam and elec. plant, gas, chemical plant, fuels, construction and maintenance work ; good linguist, keen, energetic and hardworking, DESIRES responsible POST.—Address, P5893, The Engineer Office. P5893 B

ENGINEER (30) SEEKS RESPONSIBLE POSITION ; public school education, experienced shops, D.O., assistant engineer, works extensions and maintenance.—BM/Lo24, London, W.C. 1. P5860 B

MAINTENANCE ENGINEER.—Good PRACTICAL ENGINEER, expert on plant construction, plant repairs and plant layout, SEEKS POST. Good testimonials.—Address, P5861, The Engineer Office. P5861 B

MECHANICAL and ELECTRICAL ENGINEER (30), with 12 years' sound practical experience in works production, plant maintenance, drawing-office, &c., DESIRES progressive POST ; excellent credentials.—Address, P5891, The Engineer Office. P5891 B

MECHANICAL ENGINEER (39), B.O.T. Certificate, wide experience, good education, several years in present chief managerial position in Far East, DESIRES RESPONSIBLE EXECUTIVE APPOINTMENT in England, South preferred. Capable organiser ; of proved inventive ability ; excellent and continuous references from time of apprenticeship. Available 1930. —Address, P5873, The Engineer Office. P5873 B

YOUNG MAN (26) REQUIRES JOB as TRACER. Copies and testimonial.—Address, P5868, The Engineer Office. P5868 B

YOUNG Educated AUTOMOBILE and MECHANICAL ENGINEER SEEKS POST as ASSISTANT RATE FIXER. Highest references.—17, Pearl-road, E. 17, London. P5886 B

DESIGNER, Experienced in Latest Practice Air and water-cooled aero-engines, SEEKS RESPONSIBLE POST.—Address, P5889, The Engineer Office. P5889 B

ENGINEER DRAUGHTSMAN SEEKS APPOINTMENT with first-class firm of engineers and contractors. Specialised boiler plant layouts, general engineering. Exceptional experience up-to-date waste heat boiler plants, including detailing out and erection.—Address, P5890, The Engineer Office. P5890 B

MACHINERY, &c., WANTED

WANTED, TWO Modern SECOND-HAND LANCASHIRE BOILERS, 30ft. by 8ft. 6in., insured for 160 lb. pressure, complete with Superheaters.—Address, 2052, The Engineer Office. 2052 F

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Air Mails and Ships.

SEVERAL attempts, not all of them successful, have been made to institute as a regular feature of ocean voyages, the despatch of mails by aeroplanes from the decks of liners when they arrive within flying distance of their destinations. By this plan a few hours can undoubtedly be saved in the delivery of the mails, but whether the saving justifies the expense of carrying an aeroplane and one or two pilots backwards and forwards in idleness except for two or three hours at the end of each voyage, is very doubtful. A more economical scheme, if it is practicable, is to have an aeroplane meet the liner some distance out at sea and return to land after having picked up the mails. The problem involved lies in devising a satisfactory and safe method of picking up the mails. The direct and obvious way would be to employ a seaplane which could alight on the sea and pick up the mails, which would be flung overboard from the liner. Such a plan would, however, probably result in the loss of the mails if the sea were rough. In any event time would be lost in the alighting and restarting of the seaplane. When the "Leviathan," which sailed from Southampton last Saturday arrives at a point 600 miles from New York, an alternative plan will be tried. At that point she will be met by an aeroplane which will drop a cable 150ft. long, with a particular design of grapnel at its end. Flying up the wind the pilot will cause the cable to pass into a trap-like device 60ft. wide at the mouth and 35ft. deep carried on a turntable on the liner's deck. The grapnel will engage with a rope attached to the mail bag, which at the instant of engagement will be catapulted into the air with the object of relieving the aeroplane of the sudden shock which would otherwise be caused by the taking up of the extra weight. The inventor of the system, an American, Dr. L. S. Adams, claims that weights up to 200 lb. can be picked up by his method, and that it is also useful for the dropping of packages from an aeroplane on to a vessel at sea.

The Bursting of Mains in Streets.

IN its report issued this week the Special Burst Mains Committee of the Surveyors' Institution hardly encourages the view fostered by the surveyors and engineers to local authorities that the recent series of bursts and explosions in mains beneath the roads of London and other cities is to be ascribed either to coincidence or abnormal circumstances. The Committee states that modern road traffic has necessitated methods of road construction which in crowded districts have thrown on underground pipes and services stresses which they were never intended to bear. In some streets the conduits or pipes are immediately below or are actually embedded in the surface crust in such a way that the vibration from vehicles fitted with solid tires is transmitted directly to them. Mains and pipes have been multiplied in number, and at the same time road cambers have been lowered and the thickness of the road crust has been increased, with the result that in many cases the cushion of earth which previously absorbed and distributed the pressure and vibration has been reduced almost to nothing. Repeated opening of the subsoil by excavation has caused subsidences and voids to form, and the conditions under which the refilling of the excavations has been carried out have not helped to improve matters. As regards gas explosions, the Committee points out that the disappearance of unpaved forecourts and the creation of impervious road surfaces have removed outlets which formerly existed for the escape of gas which might accumulate by leakage or otherwise in the soil. As a consequence the gas now finds its way into abandoned sewers, subsoil cavities, chambers adjoining vaults or basements. The Committee recommends that local authorities should be given additional powers to control the laying of all underground mains and conduits and the proper carrying out of excavation works. It also recommends that abandoned sewers and mains should be filled in and makes various recommendations concerning the size and material of underground pipes.

The Patent Office Report.

IN his report on the activities of the Patent Office during 1928 Mr. W. S. Jarratt, the Comptroller-General, calls attention to the increase in the number of inventions during recent years, and particularly during the year under review. The number of applications relating to gramophones and similar sound-recording and reproducing apparatus, including sound records and the associated working of such apparatus with kinematographs was nearly double that of 1927. The main activity was in connection with loud speakers, electrical-reproducing devices, such as "pick ups" and synchronised sound and picture reproduction apparatus. At the beginning of the expansion in the number of applications, the greatest increase was shown in the chemical and electrical industries; but other industries have followed suit, and the activity is now widely distributed over the whole field of invention. Much attention was devoted to low-temperature carbonisation processes and to the production and treatment of oils. In the electrical industries the development in high-tension distribution consequent upon the schemes of the Electricity Board were reflected in the large number of applications for protection systems and switchgear. Applications relating to electric heating increased, especially in respect of induction furnaces and apparatus for domestic purposes. In mechanical engineering much interest was manifested in improving the propulsion of air and seacraft. The total number of applications received last year was 38,556, or 3087 more than the number received in 1927, and the largest number in the history of the Patent Office.

Birthday Honours.

SCIENTISTS and engineers and those associated with industrial enterprises closely connected with engineering are not so freely honoured by the King as politicians and public servants, but the Birthday Honours list this year contains a fair number of names of men in the engineering world. We may place first Sir Arthur Balfour, managing director of Arthur Balfour and Co. Ltd., of Sheffield, who has been created a baronet; and in the second place Professor H. C. H. Carpenter, F.R.S., Professor of Metallurgy at the Royal School of Mines, who has received the honour of knighthood. Sir Arthur McDougall Duckham, K.C.B., has been made a G.B.E.; Mr. A. W. Johns, C.B.E., Deputy Director of Naval Construction, a C.B.; and Engineer-Captain J. J. C. Brand, of the Royal Australian Navy (Ret.), a C.B.E. Mr. R. T. Nugent, director of the Federation of British Industries, which naturally concerns itself a great deal with the engineering industries, has been knighted. We should also add that Lord Inchcape, chairman of the P. and O. and the British India Steam Navigation Companies, has been given an earldom, and that the Rt. Hon. William Clive Bridgeman, First Lord of the Admiralty, has been made a viscount. Amongst other names we note Messrs. P. N. H. Jones, Director of Public Works, Bermuda, C.B.E.; J. C. Walker, Chief Engineer, Sudan Government Railways, O.B.E.; H. T. Benson, Locomotive Works Manager of the same railways, M.B.E.; N. White, Chief Engineer, Government of the Punjab Irrigation Branch, C.B.E.; J. McGlasham, Chief Engineer, Port Commissioner of Calcutta, C.I.E.; and M. Lea, late chief engineer, Karachi Municipality, C.I.E. In the railway world we note that a knighthood has been conferred on P. C. Sheridan, who recently retired from the Indian Railway Board. Several lesser honours have fallen to the share of other railway men at home and abroad.

A Reconstructed Liner.

ON Monday morning last, June 3rd, the Blue Star liner "Arandora Star" reached Tilbury after a voyage round from the Clyde. The vessel, it will be recalled, was built by Cammell Laird and Co., Ltd., in 1926 for the Blue Star passenger and refrigerated cargo service between this country and South America. About six months ago it was decided to reconstruct the ship so as to fit her for cruising services. The work was entrusted to the Fairfield Shipbuilding and Engineering Company, Ltd., of Govan, and it has been completed in the short space of four and a-half months. Her original passenger accommodation for about 150 persons has been increased to enable 350 passengers to be carried. Three of the refrigerated holds of the ship have been converted into passenger accommodation, and extensions have been made to the upper and lower promenade decks, both of which are over 180ft. in length. On the lower promenade deck there is now a fine range of public rooms, including a lounge, music room, smoking room, ball room and garden lounge. An open-air swimming bath has been built on the lower promenade deck, and there is a new gymnasium overlooking the upper promenade deck. Most of the new cabins are exceptionally large, and all are fitted with hot and cold water supply, many being single-berth cabins, although the majority are double-berth cabins, some of which have an additional Pullman berth. The new ship is scheduled to begin her cruising programme on June 15th.

Safety of Life at Sea.

ON Friday last, May 31st, the final meeting of the International Conference on the Safety of Life at Sea, was held at the Foreign Office, the chair being taken by Vice-Admiral Sir Herbert Richmond, K.C.B., President of the Conference. After the draft convention had been presented by Senator Rio, of the French delegation, the chairmen of the different technical committees spoke, and the adoption of the convention was moved by Admiral Richmond, who referred to the sequence of events leading up to the present Conference and the work upon which the delegates had been engaged. The President of the Board of Trade, Sir Philip Cunliffe-Lister, thanked the delegates on behalf of the British Government, which had convened the Conference. The main provisions of the new convention may be summarised as follows:—The 1914 standard of subdivision for passenger ships, with some adjustment, has been found reasonable, and a new standard for intermediate ships has been approved. The criterion of service with a slight modification has been found to express adequately the extent to which a vessel may be regarded as a passenger ship. The Conference has emphasised the importance of the ready availability of lifeboats, and has reaffirmed the principle of boat accommodation for all on board, in the case of passenger-carrying ships. Life jackets, buoyant apparatus and life rafts are also made the subject of special provisions. With regard to radio-telegraphy, it is proposed to bring all ships engaged in international voyages under this convention, with the exception of cargo ships of less than 1600 tons gross. Further, all ships are required to carry an efficient installation and a qualified operator, subject to right of postponement of the application of this principle for vessels between 1600 and 2000 tons. The ice patrol, derelict service, and system of North Atlantic tracks are to be continued, and after midnight on June 30th, 1931, all helm or steering orders on ships covered by the convention must be given in the direct sense—that is, when the ship is going ahead, an order containing the words "starboard" or "right" shall only be used when it is intended that the wheel, rudder blade, and the head of the ship shall all move to the right. The convention was officially signed on the afternoon of Friday of last week, May 31st.

The Pinkston Power Station.

THE application of the Glasgow Corporation to extend the tramways electric generating station at Pinkston has been refused by the Electricity Commissioners, who, after having given careful consideration to the evidence which was adduced at the inquiry held in connection with the matter, have come to the conclusion that no case for the extension of the station has been made out. In a letter to the Corporation the Commissioners express the hope that the Corporation will now proceed to meet any additional requirements of the tramway undertaking from the Dalmarnock Station, or from other sources available under the Electricity (Supply) Acts, 1882–1928. The Corporation's proposals provided for an expenditure of £237,000 on the reconditioning of the existing plant at the Pinkston Station, and the installation of a spare set in order to provide for the power requirements of the tramway department. The scheme was drafted several years ago, and it was again taken up early last year and sanctioned by the Corporation. Application was then made to the Electricity Commissioners for their approval, but before coming to a decision the Commissioners ordered an inquiry to be held into the matter, with the result that the Corporation's proposals have now been rejected. The decision is said to have been received with much disappointment by the members of the Corporation Tramway Committee, who held that the Pinkston generating station has produced electric current at a cheaper rate than any other similar undertaking in the United Kingdom.

Leakage of Heat into Insulated Spaces.

A REPORT, published this week by the Food Investigation Board, gives an account of an interesting and important research recently conducted by J. and E. Hall, Ltd., of Dartford, with the Board's assistance, on the leakage of heat into the insulated holds of ships. The experiments described were conducted on a representative ship with twelve insulated spaces, four holds, four main 'tween decks, and four upper 'tween decks. The insulating material was for the most part granulated cork from 10in. to 12½in. thick. During the experiments the vessel was in port and empty of cargo. The external conditions were those of an English autumn. The results are, therefore, not claimed to be of general applicability but are advanced merely as an initial effort in a difficult field of investigation which will require fuller study. The experimental method employed consisted of determining the rate of refrigeration required to maintain the temperature of all the insulated spaces constant at about 6 deg. Fah. When equilibrium was established the leakage of heat into the spaces would be just equal to the heat removed from them by the refrigerating system. The results arrived at were expressed in terms of the leakage in B.Th.U. per hour per square foot of exposed surface per degree Fahrenheit difference between the external and internal temperature. It was found that this "coefficient of leakage" averaged 0·22 for the main 'tween deck spaces; 0·13 for the upper 'tween deck spaces; and 0·08 for the holds. An explanation is advanced to account for the differences in these figures. In the 'tween deck spaces the steel decks were not insulated on their upper surfaces. Consequently heat could leak in from the sides of the ship along the steel decks and so into the insulated spaces. The floors of the holds were of wood and therefore were not responsible for the same amount of heat leakage from the outside of the ship. Calculations are given to show that the leakage of heat along the steel decks is of the order required to explain the differences in the "coefficients of leakage."

New Sewage Disposal Works at Lytham St. Annes.

THE new sewage disposal works for the Borough of Lytham St. Annes were formally put into service on March 4th last. Thirty years or so ago Lytham and St. Annes were quite small towns, with their centres separated some 3 miles apart, the still smaller districts of Ansdell and Fairhaven lying between them. Now, the four have been combined into one large borough, which stretches for a distance of 5 miles or more in an unbroken line along the north shore of the estuary of the River Ribble. The population is constantly increasing, for the district is one of the most popular of the Lancashire seaside resorts. At the present time, the permanent residents are in the neighbourhood of 30,000, and in the holiday seasons that number is considerably increased.

The main objects of the scheme which has recently been put into operation were to remove the positions of the outfall sewers in the St. Annes and Fairhaven areas to a point which would allow the sewage to be discharged without fear of pollution of the foreshore, and to provide for the future development of the borough. The project necessitated the abandonment of existing sewer outfalls at the points marked A, B, and C on the sketch plan—Fig. 1—and the construction of a new outfall sewer extending from a pumping station near the point C to the trained channel of the River. It also involved the construction of the three Pumping Stations, Nos. 1, 2, and 3 on the plan, and of storage tanks at Station No. 1. The Borough Engineer, Mr. G. W. Lawson, M. Inst. M. and Cy. E., was responsible for the design and supervision of the whole scheme, with the exception of the storage tanks and pumping station No. 1, which were designed by Messrs. John Taylor and Sons, of Westminster, who also acted as consultants for the remainder of the undertaking. Mr. J. C. Fairchild was responsible for the whole of the electrical equipment.

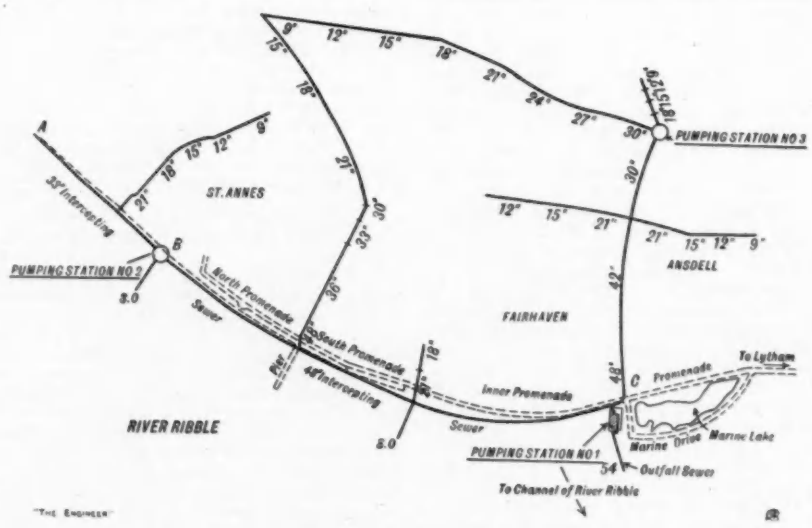


FIG. 1—PLAN OF LYTHAM ST. ANNES SEWERAGE SYSTEM

The arrangements are such that sewage gravitates to each of the three pumping stations. At pumping stations Nos. 2 and 3 the sewage is lifted into sewers at a higher level, so that it may gravitate to pumping station No. 1. What takes place there will be explained later. Meanwhile, we may say that an intercepting sewer varying in diameter from 33in. to 48in., was laid along the foreshore from near point A in the plan to pumping station No. 1. Other new main sewers, connected to this intercepting sewer at various points, tap the pre-existing sewers and make provision for sewering the outlying district to the north-west, in the direction of Blackpool, which is being rapidly developed. All these sewers are composed of concrete pipes, varying in diameter from 9in. to 48in., and the total length of new sewers laid was about 8 miles. The various diameters of sewers used are shown in Fig. 1.

From pumping stations Nos. 2 and 3 the sewage is pumped, unscreened, into the sewers leading to Pumping Station No. 1. At the latter, however, it is passed through motor-driven bar screens, in duplicate, which are mechanically cleaned, before being raised into two large storage tanks—see Fig. 2—which have a combined capacity of 2,000,000 gallons, where it is retained till the ebb sets in in the River, when it is discharged through automatically operated penstocks into a 54in. cast iron pipe, which is laid on the bed of the estuary and is taken in a direct line to the trained channel of the River, as mentioned above, a distance of 1500 yards. Float experiments have shown that sewage, discharged at this point on the ebb, is taken by the tide some miles out to sea. The inlet and outlet penstocks at the storage tanks, and the screen motors are furnished with push-button control, with lamps indicating when the penstocks are fully open or fully closed. In addition to this arrangement, the two sets of outlet penstocks are controlled by automatic time switches, which are set to open their penstocks during the ebb tide, and to close them at any time afterwards that may be desired. The penstocks can also be operated by hand in the event of failure of the electric current. There is a float alarm switch connected with a bell, and, should the water level in both tanks reach a certain level, alarm signals are sent by it to the Corporation's Electricity Works, from which the penstocks can be operated as well as on the site.

Each of the storage tanks is 250ft. long by 50ft. wide, and about 14ft. deep. The main walls and floors are constructed in mass concrete, while the roofs and division wall are in reinforced concrete. The roof slabs are 6in. thick, and are carried on beams supported by reinforced concrete columns. The floor of each tank is divided into three inverted bays, which have a fall of 2ft. between the inlet and outlet channels. The high-water level in these tanks is at such a height that the tanks can be discharged at any state of the tide, and overflow weirs are provided to allow the tanks to be filled or emptied should anything go wrong with the penstocks. All controls are kept clear of the tanks, being arranged in a special penstock chamber. To provide against breakdown of the pumping plant, which we are about to describe, there is an arrangement by which the sewage can be by-passed by an overflow sewer, while a tidal valve at the main outfall will prevent water from the estuary entering the outfall sewer. The overflow sewer has also a flap valve to prevent any discharge from the tanks entering the sewer. The intercepting sewer has two storm overflows at the points indicated in Fig. 1. The sewers, tanks and pump-house are all efficiently ventilated.

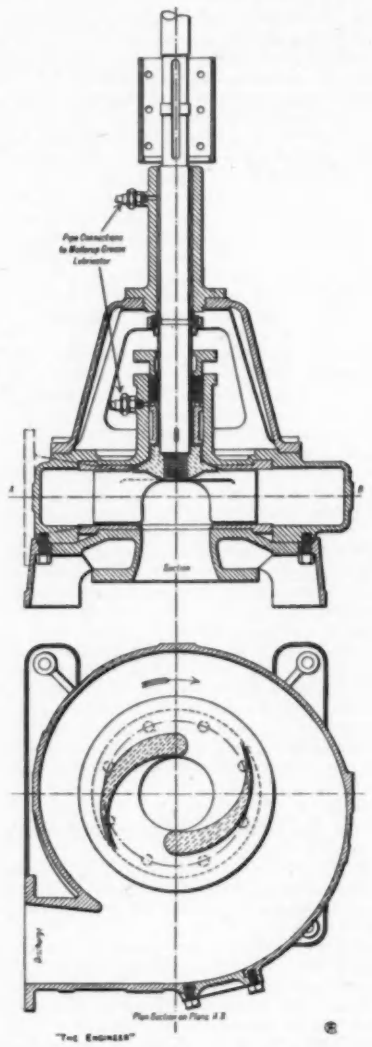


FIG. 3—SECTIONS OF "NON-CLOG" PUMP

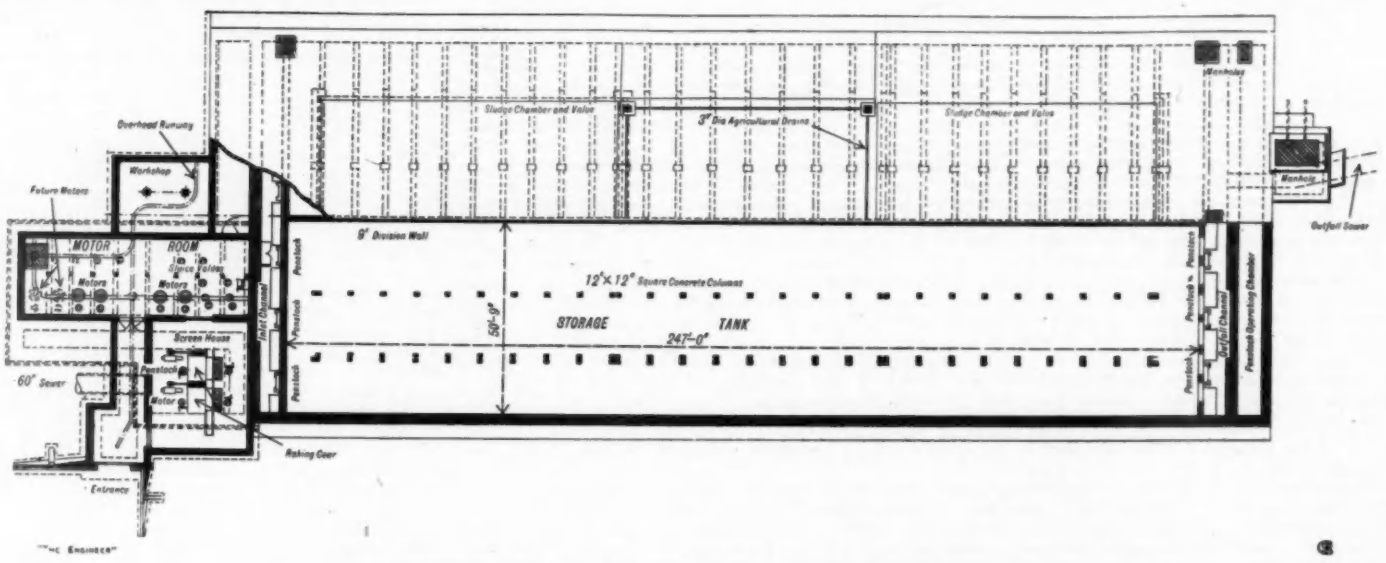


FIG. 2—PLAN OF PUMPING STATION NO. 1 AND STORAGE TANKS

The largest pumping plant is, naturally, at the main or No. 1 pumping station. There the plant comprises (*a*) four electrically driven vertical-spindle "Non-Clog" pumps, made by the Rees Roturbo Manufacturing Company, Ltd., each designed to discharge 300,000 gallons per hour against a total manometric head of 31ft. when running at a speed of 580 r.p.m., the horse-power of the motors being 75; and (*b*) two similar pumps, supplied by the same makers, each designed to deliver 96,000 gallons per hour against a total head of 19ft. when running at a speed of 720 r.p.m., and driven by a 21 H.P. motor. The two smaller pumps will be used to deal with the dry-weather flow, while the larger pumps will be used for dealing with storm water.

The plant at Pumping Station No. 2 consists of two vertical-spindle "Non-Clogg" Rees Roturbo pumps, which are counterparts in every way of the smaller pumps at No. 1 station, each of which is designed to deliver 96,000 gallons per hour against a total head of 23ft., when driven by 21 H.P. motors running at 720 r.p.m. Pumping Station No. 3 contains two similar pumps, each designed to deliver 78,000 gallons per hour against a total head of 33ft. when running at 720 r.p.m., and driven by a 22 H.P. motor.

Each of the four 300,000 gallons per hour pumps at No. 1 station has 20in. suction and 16in. discharge branches, and is capable, so the makers inform us, of passing solids having dimensions up to 8in. diameter spheres. The smaller pumps in all three stations have 10in. suction and 8in. discharge branches, and can pass solids up to 5in. diameter spheres. The larger pumps at No. 1 station were specified to have an efficiency of 72 per cent. Actually, efficiencies of 80 per cent. and over were, we understand, obtained at the makers' works when pumping water. The smaller pumps at No. 1 station each had a guaranteed efficiency of 69 per cent., while those at stations Nos. 2 and 3 had guaranteed efficiencies of 65 per cent. The actual efficiencies obtained on test on water at the maker's works on all these six pumps, varied, so we understand, between 78 and 81 per cent. It may here be mentioned that the motors at No. 1 station were supplied by the British Thomson-Houston Company, Ltd., while those at stations Nos. 2 and 3 were made by Crompton-Parkinson, Ltd.

The "Non-Clogg" pumps are of the Rees Roturbo Company's patented design. They have open-sided two-bladed propellers, the passages through which are made of specially large area to pass bulky solids, and are shaped with the idea of avoiding projections round which weeds, rags or the like might become wrapped, and cavities in which solid matter might collect. Sections through one of the pumps are given in Fig. 3, while a view of one of the impellers is given in Fig. 4. As will be observed, the blades have their leading or inlet edges of bulbous shape, and taper to a relatively thin trailing or outlet edge, so that, in section, they have a stream-line formation. The makers point out that this construction allows any stringy or fibrous matter to slide over the blades without danger of entanglement, and therefore reduces the frictional resistance met with by the water and solid matter in passing over the blades. The impellers, which are of cast steel and have been made specially robust so as to minimise the risk of breakage from shock, are screwed to the ends of the pump shafts, so that there may be no projections round which objects passing through the pump may become wrapped. At the outer periphery of the impeller,

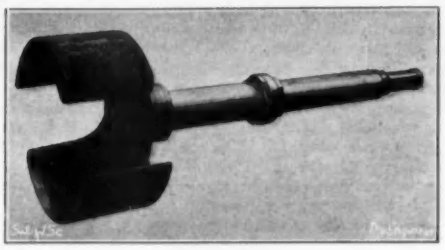


FIG. 4—"NON-CLOG" IMPELLER

and between it and the casing, a large annular chamber is provided with a view to eliminate the danger of solid matter jamming between the blades and the casings.

The pump casings are fitted internally with renewable hard chilled iron side plates, arranged so as to be readily adjustable for wear. The covers underneath the casings are removable and the casings are carried on concrete plinths. Just above the main bearing on each pump there is a muff coupling, so that the impeller and shaft can be disconnected from the main vertical shaft and removed from the pump from underneath, without the pump casing or discharge pipe joint being disturbed.

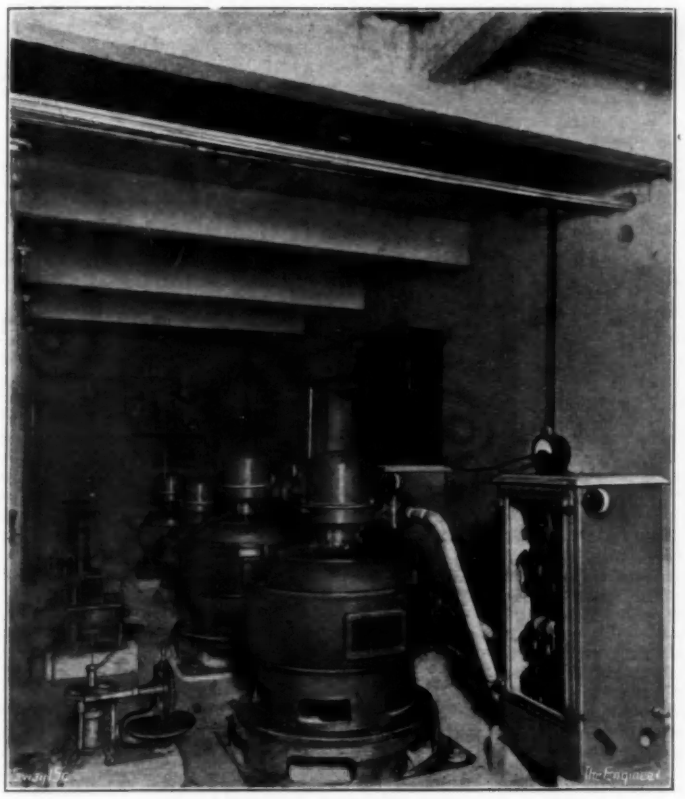
There are no bearings underneath the pump impellers, so that a free way is left for solid matters to pass through, the impellers being overhung at the ends of the spindles. The latter are of nickel steel, and are furnished with specially hard stainless steel sleeves where they pass through the stuffing-box. In addition to the usual internal bushes, there are long external bearings for guiding the spindles, and to prevent whipping. The intermediate shafts are of mild steel and are connected to the pump spindles by muff couplings. At the top of each intermediate shaft is a pin type coupling for connection to the driving motor. The weight of the motor, together with that of the intermediate shafting, spindle, and impeller, are carried by a cast iron stool, which is furnished with a flange for resting on supporting girders. In each stool is a ball-thrust bearing to take the weight of the shafting and rotating parts of the pump, and there is a journal bearing immediately under this thrust bearing to steady the shaft. The lubrication of the vertical shaft bearing, the pump bearing and the bushes is effected by means of mechanically operated "Mollerup" grease lubricators, which are driven by belt from the motor spindle. The lubricators are filled at intervals by the attendant when making periodical visits of inspection, but apart from that, we gather that the pumping plant runs unattended.

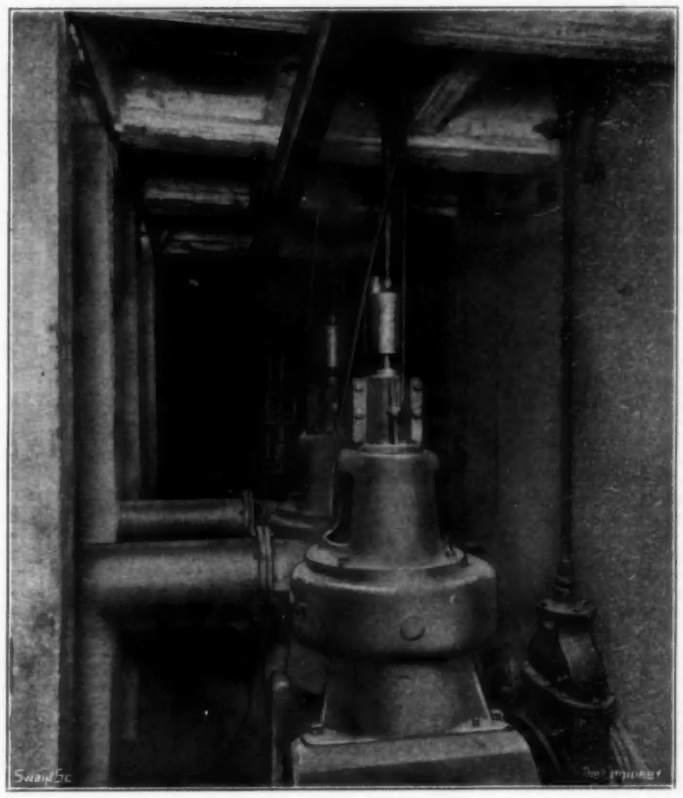
The pumps are all arranged to be separately started and stopped automatically by means of float switches controlled by the level of the sewage in the suction chambers. The screening plant motor at No. 1 station is interlocked with those of the main pumps, so that the screens can only be operated when the pumps are running. The motors at all three stations are of the slip-ring induction type, designed to operate with 415-volt, 50 period, three-phase current supplied to them through automatic contact pillars to protect them against overload and failure of the supply.

The automatic control panels, which are totally enclosed with hinged glazed inspection doors, include adjustable timing devices and triple-pole, hand-operated main isolating switches. At station No. 1 there is a four-way selection switch, which enables the sets to be started and stopped in any desired sequence, so that the duty may be divided as evenly as possible between the pumps. The control gear at all three stations was manufactured by Electric Control, Ltd. Views in the motor-room and pump chamber are given in Figs. 5 and 6 respectively.

In order to insure against breakdowns, the electric supply is taken into the pumping stations in duplicate from the Corporation's supply mains, as follows:—(1) 6600-volt, three-phase, 50 periods, from the E.H.T. ring main; and (2) 415-volt, three-phase, 50 periods, from the low-tension mains. Both supplies are taken to a switchboard from which the supply to the motors is led through loose-handle, oil-break circuit breakers, provided with safety locking gear.

The main contractor for the sewerage works, &c. was James Byrom, Ltd., of Bury, who carried out all of them except the tanks and the pump-house building at No. 1 station, for which S. and J. Smethurst, Ltd., of Oldham, were the contractors. The pumping plant was provided and erected by the Rees Roturbo Manufacturing Company, Ltd., of Wolverhampton; the screening plant by Whitehead and Poole, of Radcliffe; the penstocks by J. Blakeborough and Sons, Ltd., of Brighouse, Yorks.; the cast iron pipes by the Staveley Coal and Iron Company, Ltd., of Chesterfield; and the concrete pipes by the Stanton Iron Company, Ltd., of Nottingham. The cost of the whole scheme is approximately £375,000.





FIGS. 5 AND 6—PUMPING STATION NO. 1—MOTOR ROOM AND PUMP CHAMBER

THERE is a very extensive literature on the subject of the effects of temperature on the setting times and strengths of cements and concretes, but the mass of data available is confused and unco-ordinated. The Building Research Station of the Department of Scientific and Industrial Research accordingly experienced difficulty in dealing with numerous inquiries received for information on these matters; also it was found necessary to attempt some condensation before the data could be of service in connection with the research work in progress. Dr. W. N. Thomas undertook the laborious task of summarising the literature, and Mr. Davey has carried out some experimental work in an attempt to clear up a number of disputed points. It is thought that Dr. Thomas's critical survey, which has just been issued by H.M. Stationery Office, price 1s., will prove of value to all users of cements and concretes.

The Shannon Power Scheme.

No. VII. (*conclusion*).*

THE economic aspects of the Shannon power scheme were dealt with in a paper by Mr. J. M. Fay, M.Sc., B.E., read before the Institution of Civil Engineers (Ireland), on December 5th, 1927.

With the installed capacity of 90,000 horse-power it will be possible to supply 153 million units in the driest year, estimated from a consideration of the records for the past thirty years, and by means of the storage provisions to distribute this power throughout the year in such a manner as to correspond with the estimated requirement curve for the country. The amount of power that can be generated in a normal year with the partial development scheme is estimated at 288 million units and in a wet year at 373 million units. In considering the economics of the scheme, however, the figures were based on the output in the driest year—namely, 153 million units—which will be referred to as first-class power, as this provides a conservative basis for the scheme. The estimated capital expenditure is given as £5,210,000, which is divided approximately as follows :—£2,510,000 for civil constructional works, £2,000,000 for electrical and mechanical works, and £700,000 for interest during construction, &c. In considering the annual working expenses, interest is reckoned at 5½ per cent. and amortisation at forty years, and full provision is made for repairs and renewals. The cost of power at various points has been estimated from tables in the experts' report. The annual working costs are estimated as follows :—

	Per annum.
Power plant alone	£264,000
Power plant and 110-kV lines	£315,000
Power plant plus 110-kV lines plus 38·5-kV lines	£438,000
Power plant plus 110-kV lines plus 38·5-kV lines plus 10-kV lines	£486,000

The total annual output of first-class power has been already given as 153 million units per annum. Consequently the cost of power at the power station is estimated at $\frac{£264,000 \times 240}{153,000,000} = \cdot41$d. per unit.

The loss of energy in the 110-kV system is estimated at 8 million units per annum, so that, assuming all the power to pass over this system and the amount of power delivered at the ends to be 145 million units, the cost of power at the end of the system is estimated at

$$\frac{£315,000 \times 240}{145,000,000} = \cdot52\text{d. per unit.}$$

Assuming that 95·6 million units were sold at the end of the 110-kV system and 49·4 were delivered to the 38·5-kV system, this latter figure would be reduced to 45·8 million units delivered at the end of the 38·5-kV system, so that if we assume that all the power were sold at a flat rate at the ends of the 110-kV and 38·5-kV system, the cost of power delivered should then be as follows :—

$$\frac{£438,000 \times 240}{141,400,000} = \cdot74\text{d. per unit.}$$

By adding the 10-kV system and assuming that 18,100,000 units were delivered to the 10-kV system this figure would be reduced to 16,300,000 units by losses in the 10-kV system, so that adding the total amount of power delivered to consumers at the ends of the three systems in order to arrive at a flat rate for the cost of power, we get the following result :—

$$\frac{486,000 \times 240}{139,600,000} = \cdot84\text{d. per unit.}$$

The question of the cost of power may be approached from another point of view. It may be assumed that the cost of power at the end of the primary system is ·52d. per unit. The secondary system—namely, the 38·5-kV system—may be regarded as an additional work required for the service of a number of other consumers throughout the country. The whole charge for this secondary system may be debited against the units passing over it to these consumers. The annual expenditure on this secondary system is given as £438,000 — £315,000 = £123,000. The amount of power passing over the secondary system is 45,800,000 units, so that the average cost per unit for power due to the secondary system is :—

$$\frac{£123,000 \times 240}{45,800,000} = \cdot65\text{d.}$$

Adding this to the cost of power at the end of the primary system we get as a total cost of power at the end of the secondary system ·52d. + ·65d. = 1·17d. This is given in the Experts' Report as 1·21d.

If we deal similarly with the 10-kV system we find that the annual cost of this system is £486,000 — £438,000 = £48,000, and the amount of power delivered at the end of this system is 16,300,000 units, so that the additional cost of power transmitted over the tertiary system would be $\frac{£48,000 \times 240}{16,300,000}$ = ·71d. Consequently the cost of power delivered at the end of the 10-kV system would be 1·21d. plus ·71d. = 1·92d. This is given in the Experts' Report as 2·06d. per unit.

* No. VI. appeared May 31st.

It will be noted that the total amount of first-class power delivered at the transformer stations throughout the country has been given as approximately 139 million units. If we approach the problem from the other end and consider the consumption necessary to utilise fully these 139 million units we find that the Experts' Report gives the figure of 110 million units. The difference between the 139 million units delivered at the transformer stations throughout the country and the 110 million units consumed represents the losses in distribution, and is approximately 20 per cent. of the supply. As there has been considerable misunderstanding concerning this figure it may be well to emphasise that the 139 million units represents the energy measured on the low-tension side of the transformer stations throughout the country, and the 110 million units represents the energy registered on meters in the consumers' houses.

To arrive at this consumption of 110 million units the experts divided the demand as follows :—

	Population.	Consumption per head.	Total consumption units.
Cities	514,000	115	59,000,000
Large towns	230,000	55	13,000,000
Small towns	300,000 (approx.)	30	9,000,000
Country			9,000,000
Total			90,000,000
Heating units			20,000,000
Total			110,000,000

Bulk Supply.

	Necessary bulk supply to meet above demand. Units.	Price per unit.	Total.
		d.	d.
Cities	74,000,000	·52	38·5 million
Large towns	16,000,000	1·21	19·5 ,,
Small towns	24,000,000	2·06	49·5 ,,
Country			
Total	114,000,000		107·5 million = £450,000
Heating units	25,000,000	·35	8,750,000
Total	139,000,000	—	116,250,000 = £484,000 per annum

Alternatively, as previously pointed out, the cost might be estimated at an average of ·84d. per unit for power at all transformer stations—namely, 139 million units at ·84d. per unit = 17,000,000d. = £486,000. It is also to be observed that if the sales of the 20 million units at a low rate for heating purposes were omitted the total consumption to be obtained is 90 million units per annum. The approximate figure included above for rural consumption is 9 million units per annum; the actual figure given in the Experts' Report being 8·96 million units per annum. Frequent reference has been made to the improbability of the farming community taking any considerable supply from the Shannon in the near future, and the idea appears to be prevalent that the failure of the farmers to take a supply would cause serious interference with the economic position of the Shannon power development. The approximate amount of 9 million units is allocated to the country, but only 3 million units has been credited to the farmers, the other 6 million being due to mills and creameries. Consequently the position of the farmer under the Shannon power development will be that if a number of farmers require power in any area they can obtain the supply of power at a very reasonable rate; but if, on the other hand, the farmers should fail to take advantage of the opportunity the effect on the estimate for the consumption of power will be very slight indeed.

The expenditure table in the Siemens Schuckert Report has been modified by the Experts' Report in three important particulars. The interest has been altered to 5·5 per cent. the period of amortisation has been extended to forty years, and the estimated costs of management and staff has been increased to £75,000 per year. With these modifications the important items of the expenditure may be stated approximately as follows :—

	£
1. Interest on capital	290,000
2. Sinking fund	40,000
3. Renewals	55,000
4. Repairs	16,000
5. Cost of management, staff, &c.	75,000
Total	£476,000

The above table contains only the large items in the annual expenditure, and even these items have been somewhat modified, but it represents essentially the allocation of the expenditure under the important headings. Items 2, 3 and 4, representing an annual amount of approximately £110,000, will be deposited to the credit of the various funds and held for the Shannon works. These funds will, no doubt, act to some extent as compensating reservoirs in connection with the financial operations of the works, the essential feature being that the allocations to these funds should average the amount indicated over periods of five years. The result of this arrangement will be that at the end of the amortisation period the sinking fund should have redeemed the total cost and the repair and renewal funds should have kept the plant in first-class condition so that at that time the Shannon works should be the property of the nation, without any further interest or sinking fund charges.

The Siemens Schuckert Report gives 115,000,000 units per annum as the energy requirements of the Irish railways if they were all electrified. If we consider the Great Southern Railways system the capital cost of complete electrification might be estimated as follows :—

	£
Capital cost of new construction, 2700 miles of track at £6000 per mile	16,000,000
Cost of electric locomotives to be supplied over a number of years	4,000,000
	£20,000,000

The only item in the annual expenditure in which an obvious saving can be effected by the electrification of the system is the item of locomotive running expenses. In the details of locomotive running expenses the following items occur :—

	£
Wages in connection with the running of locomotives	443,091
Fuel	433,095
Water	23,968
	£900,064

The electrification of the railways would cancel the fuel costs and might reduce the wages cost considerably, so that the corresponding costs of the electrified railway might be estimated as follows :—

	£
Cost of electric energy	200,000
Wages costs	400,000
	£600,000

This would indicate a saving of about £300,000 per annum, which, from a consideration of interest charges alone, would appear to justify a capital expenditure of £5,000,000. It has been indicated above that the total estimated capital required to electrify the Great Southern railways would be £20,000,000, so that it is clear that complete electrification would be uneconomic.

If we examine a busy section of the line such as the Dublin-Bray section, it is possible that the conclusions reached would be different. If we assume for the sake of argument that the expenses of the Dublin-Bray line could be reduced by £6000 per year by electrification this saving would pay interest at 6 per cent. on a capital expenditure of £100,000. The capital cost of electrification might be less than the latter figure, so that such a scheme might warrant detailed consideration in view of the consequent improvement to the amenities of the district through which this railway passes.

It should be realised that works such as the Shannon works are primarily designed to supply the needs of the general public. A publication dealing with the State power plants in Sweden, dated 1921, contains the following statement with reference to the Trollhatten power station :—

> "The large power deliveries to electro-chemical industries are of a temporary nature serving to keep the plant working at full load until the entire output is claimed for other purposes. All hydro-electrical energy utilised in Gota Alv is to be reserved primarily for household needs, such as heating and cooking, for the motors of industry and small trade, for railway electrification, and for use in other fields where energy is efficiently utilised."

The utilisation of the surplus power available during the winter of every year and also during the summer, except in the driest years, is quite another matter, and it will be important to arrange for the disposal of this power which will be referred to as second-class power or surplus power inasmuch as the supply cannot always be guaranteed The surplus power available during the partial development is estimated as follows :—

	Units.
For a dry year	90,000,000
For a year of normal rainfall	135,000,000

In Mr. Fay's opinion an ideal solution of this surplus power problem might be found in the development of a large scale peat fuel enterprise which would take power for artificial saving of peat during the winter and during wet summers and would carry out the process of saving the peat by the ordinary sun and air drying method during dry summers when surplus power is not available.

Other industries which have often been mentioned when the question of the utilisation of Shannon power on a large scale has been under consideration, have been the nitrogen fixation industry and the cement industry. The following table shows approximately the amount of energy required for the production of fixed nitrogen by the different methods :—

Power Required for Nitrogen Fixation.

Process.	KWh per kg. of N.	Kw year per ton of N.
Arc	73·3	8·41
Cyanamide	18	2·2
Casale	18	2·2
Haber	3·6	·435

The value of 1 kilo. of fixed nitrogen may be esti-

mated at somewhat more than 1s., so that it will be apparent that for the Arc process very cheap power is essential. The following table shows the relation between the cost of energy and the final cost of nitrogen product :—

Cost of energy per kW year, £	1·2	3·75	5·0	8
Corresponding price per unit of production, pence	·033	·103	·138	·220

Corresponding Cost per Ton of Nitrogen Content.

	£	£	£	£
Arc process*	31·5	51·8	62·4	87·6
Cyanamide process	19·01	24·04	28·42	32·39

* Parkington and Parker, "The Nitrogen Industry."

With the market value of fertilisers at £60 per ton of fixed nitrogen content, it would appear that for the Arc process the cost of power should not exceed ·14d. per unit. The imports of the two most important nitrogenous fertilisers into the country during the last year were as follows :—

	Tons.	Value.	Estimated N content. tons.	Cost per ton of N content.
		£		£
Sodium nitrate $NaNO_3$	1,509	18,560	240	77
Ammonium sulphate $(NH_4)_2SO_4$	15,805	180,957	3,200	60

The amount of energy required for the production of these fertilisers by the different methods might be estimated as follows :—

	Units required.
Production of 3440 tons of nitrogen—	
Arc process	250,000,000
Cyanamide process	62,000,000
Casale process	62,000,000
Haber	12·4 million

The deductions to be drawn from these figures are that surplus power might be supplied from the Shannon at a rate suitable for nitrogen fixation to a factory capable of supplying a considerable part of the national requirements, but before the commercial possibilities of such a factory can be assessed it would be necessary to examine the economic effect of the irregularity of the supply in the idle periods which would occur during dry summers when no surplus power would be available.

The Casale process can use intermittant power, and therefore provides a method of improving the load factor for the generating station, so that if other conditions for the establishment of a nitrogen fixation factory were favourable it would probably be the most suitable process to use in Ireland.

The power requirements in the cement industry are given in *Canadian Engineering*, 1925, as from 4 to 6 units per hundredweight. This power is divided as follows :—

Approximately—One-third for grinding and pulverising.
One-third for grinding clinker.
One-third for miscellaneous purposes.

The cement imports into the Free State during the years 1925 and 1926 were as follows :—

	Tons.	Value.	Approx. value per ton.
		£	£ s.
1925	132,668	386,994	2 18
1926	144,382	389,431	2 14

Taking the annual requirements of the Free State as 150,000 tons, a factory to meet this demand should use 15 million units per annum. If the cement factory could be economically operated on a seasonal basis it should form a very suitable outlet for surplus power, but it seems to be improbable that such a factory could be operated on a sectional basis in Ireland. Furthermore, it must be remembered that the cement making industry is really a chemical industry requiring constant sampling and testing to maintain a uniform product of high quality, and this is really of more importance than the actual cost of the power.

Figures have been given to indicate the possibilities of the use of surplus power in large undertakings, such as nitrogen fixation and cement manfacture, and a passing reference has been made to the possibility of the peat industry. The main fact to be noted about the surplus power is that large blocks of this power will be available, and that commercial companies that can make use of it should give the matter consideration.

The advantages which the Shannon power development should confer on the Free State have not been elaborated. These might be summarised very shortly by saying that power will be available to cities, towns and villages at a rate cheaper than could be hoped for under existing conditions. Large savings in capital expenditure will be effected. It is hoped that arrangements can be made to supply electric light even to the poorer class houses in cities, towns and villages. If this can be achieved the social effects are probably incalculable. The estimates and costs are on the basis that the works shall be self-supporting, so that these great national advantages should be realised without cost to the taxpayer.

Heat Losses in Turbine Nozzles.

By E. C. WADLOW.

As far as can be judged, the expansion of steam in a steam turbine nozzle is accompanied by little or no interchange of heat between the fluid and the nozzle wall when once conditions of equilibrium have been reached. Many years have elapsed since experiments were made in this direction, and then it was with a view to explaining the phenomena we now know to be due to supersaturation of the expanding steam, rather than to the measuring of heat loss, that such work was carried out. While the experiments themselves were hedged round with experimental difficulties, the results were generally of such a nature as to indicate that the walls abstracted very little heat from the fluid passing over them, although they might exert considerable influence upon the final state of the fluid after expansion, due mainly to friction between the fluid and the nozzle wall.

This state of affairs has no doubt been responsible for the fact that in nearly every examination of the prospects of the internal combustion turbine the possibility of serious heat leakage at this point has been totally ignored.

It will be recalled that the evolution of a successful prime mover on these lines is primarily dependent upon the adoption of high initial temperatures for the working fluid. Also, since a compact design is necessarily called for, in order to cut down radiation losses generally, it follows that the nozzles through which the fluid is to expand must be as close as possible to the combustion chamber.

The conditions under which the nozzles will have to work are therefore particularly severe, since the interior surfaces, which must maintain their original contour and finish, may be exposed to flaming hot oxidising gases which may enter the nozzle at temperatures as high as 2500 deg. Cent. and sweep over the surfaces with a velocity as great as 4500ft. per second.

In addition to being severe, then, the conditions are also quite outside anything encountered either in high-pressure steam turbine or in internal combustion engine practice.

Several writers have advocated the adoption of water cooling of the nozzle walls, even though the temperature of the expanding fluid has been reduced considerably before entering the nozzle, either by admitting excess air into the furnace, or by water injection. Judging by their observations, it would appear that the possibility of an excessive heat loss is either not contemplated or has been overlooked. Only one writer has been found[1] who seems to anticipate any considerable loss. Even in this case no definite figure is given for the nozzle loss, but he anticipated that the radiation loss to the furnace walls and the loss to the nozzle walls may together reach 10 to 15 per cent. of the heat theoretically available.

In the absence of any existing internal combustion turbines the point at issue is not one of immediate practical importance. It seems desirable, however, that attention should be directed to this point as one which must necessarily be considered in the event of any scheme for such turbines being prepared at a future date.

An Estimation of the Heat Loss to the Nozzle.

Indifferent success has attended the vast amount of research which has been carried out to determine the laws governing the rate of heat transfer from and to a gas flowing through a tube, so that to expect a satisfactory solution to the much more involved case of a gas expanding in a nozzle is, for the present, out of the question.

To obtain some idea of the possible magnitude of the heat loss in the second case, however, some rough calculations were carried out, and as it was found later that the values so obtained checked up fairly well with some experimental observations, a brief outline of the method employed may be interesting.

The basis adopted was the well-known equation developed by Stanton for the transfer of heat from a gas flowing through a tube. This takes the form

$$H = 2K\frac{M}{\pi r^2}\left[C_v\right]_t^T (T - t) \quad . \quad . \quad . \quad (1)$$

where

H = heat transferred at any cross section of the tube, C.H.U. per square foot per second.
M = weight of gas being discharged through the tube, pounds per second,
r = radius of the tube, feet,
C_v = specific heat of the gas at constant volume, C.H.U. per pound per deg. Cent.,
T = temperature of the gas, deg. Cent.
t = temperature of the tube wall, deg. Cent.,

$$K = \frac{R}{\rho V^2} = 0{\cdot}0262\left(\frac{v}{V d}\right)^{0{\cdot}35} + 0{\cdot}000028 \quad . \quad (2)$$

where

K = a non-dimensional factor,
v = coefficient of kinematic viscosity of the gas,
V = velocity of the gas in the tube,
d = diameter of the tube.

The value of v is calculated from

$$v = \frac{\mu}{\rho} \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where

v = coefficient of kinematic viscosity of the gas,
μ = absolute viscosity of the gas,
ρ = density of the gas.

These equations are stated by Tizard[2] to reproduce very accurately indeed the results of the careful experiments of Jordan,[3] and have been shown by him to reproduce, also, those of Lawford Fry,[4] relating to the flow of gases at constant pressure through tubes of constant cross sectional area.

The conditions encountered in a nozzle, however, are very different from those in the experiments just noticed. Pressures, temperatures, gas densities, velocities—to mention a few—vary with extreme rapidity over a very short distance, and during a very short time interval, and any calculations must perforce be of a very tentative nature only.

The Case of the Steam Turbine Nozzle.

Equation (1) may, first of all, be applied to the case of a nozzle expanding steam or air at moderate temperatures. It appears from the experiments of Stewart[5] that the temperature gradient along an uncooled nozzle in an axial direction closely approaches that existing in the expanding fluid, if the facilities for the removal of the heat from the nozzle are small. The factor $(T - t)$ will become very nearly constant for every elemental length of the nozzle, and of small magnitude due to the position of the nozzle in the turbine giving but a poor path for heat to escape.

On the assumption that the conduction of heat along the nozzle walls, in an axial direction, may be neglected, it would appear that at any cross section of the nozzle the wall will tend to take up the temperature of the fluid at that section. The factor $(T - t)$ therefore becomes very small and the quantity of heat abstracted from the expanding fluid very small also. This is in accordance with experiment and with experience.

As long as the temperature of the nozzle may be permitted to approximate to that of the expanding fluid and no easy path is offered for the dissipation of heat from the nozzle, then the factor $(T - t)$, and consequently the heat loss, will be small.

The Case of the Internal Combustion Turbine Nozzle.

The determining factor is therefore the heat-resisting characteristics of the nozzle material—mainly its non-scaling properties, but also its strength at elevated temperatures. Of primary importance also is the location of the nozzle, since this determines the temperature gradients from the nozzle—ultimately to the atmosphere.

Without discussing any further the selection of the material, its properties, and the nozzle position, we may pass on to consider what might happen in the worst combination of circumstances. This will occur when the nozzle is water cooled.

If the cooling is effective the conditions are such that the nozzle walls will reach a temperature slightly higher than that of the surrounding water. This temperature, moreover, will be very nearly the same at any point along the axial length, owing to the predominating influence of the liquid cooling medium as opposed to the gaseous heating medium. At the inlet to the nozzle the velocity of the expanding gas is low, but its temperature is high. Even when the gas is fully expanded and the factor $(T - t)$ is as small as possible, it may still be twenty times greater than it would be with an uncooled nozzle expanding steam.

To obtain a rough idea of the magnitude of the heat loss under these conditions an estimate has been made utilising equations (1), (2), and (3). The example selected is that of a constant-pressure turbine nozzle expanding from 115 lb. per square inch absolute to 15 lb. per square inch absolute. The temperature at inlet is taken as 1273 deg. Cent. absolute, this giving a temperature after expansion of 712 deg. Cent. absolute—assuming no losses, constant specific heats, and the working fluid to be air. The nozzle selected is of simple form, giving the correct expansion ratio with no losses. The nominal throat diameter is 0·25in., the length 1·0in., the outlet diameter 0·321in., and the radius of the inlet portion 0·3125in. One half of the nozzle profile curve is shown in Fig. 1.

Although the theoretical conditions of the gas at any distance along the nozzle axis can be calculated, the actual conditions cannot be predicted with any certainty. It is necessary, therefore, to emphasise again the fact that the following treatment is necessarily crude and cannot strictly be justified.

Fig. 1 shows, in addition to the shape of the nozzle, curves giving the following information for any point along the axis of the nozzle :—

(*a*) The theoretical gas pressure, pounds per square inch absolute.
(*b*) The theoretical gas temperature, degrees Cent. absolute.
(*c*) The theoretical gas velocity, feet per second.
(*d*) The value of K calculated from equation (2).

In addition to the information already given, it has been assumed that the initial specific volume is 7·2 cubic feet per pound of gas, giving a rate of discharge of 0·063 lb. per second. In calculating the

curve of pressures it has been assumed that the effective cross sectional area is always at right angles to the axis of the nozzle. This is very nearly true in the neighbourhood of the throat and in the diverging portion, but in the converging portion it can only be regarded as a very rough approximation owing to the rapidity with which the nozzle converges.

The density of the gas falls as the expansion takes place, the curve being similar to those of temperature and of pressure in Fig. 1. The viscosity of the expanding fluid was assumed to be the same as for air, and was calculated for a number of temperatures from the equation of Grindley and Gibson,[6] although the range of temperature employed in their experiments was much more restricted, being only from 0 deg. Cent. to 100 deg. Cent. The effect of the expansion on the value of K is comparatively small after the initial stages.

The following estimate of the heat loss has been based upon the curves in Fig. 1. For this purpose it has been found most convenient to regard the heat flow to the nozzle as being made up of two components, one radial and one axial, the axis of the nozzle being the axis of reference. The radial heat flow only is at present under discussion. It has also been assumed that the temperature of the nozzle wall is 100 deg. Cent. and that the specific heat of the gas at constant volume is 0·178 and is independent of pressure and of temperature.

The nozzle profile was divided into sections by radial planes. For each of these sections the following information was tabulated. (The mean value of any quantity was taken as the value at the middle of the section from the curves of Fig. 1.)

(*a*) Length, inch.
(*b*) Mean radius, inch.
(*c*) Mean perimeter, inches.
(*d*) Surface area of nozzle wall in each section, square inch.
(*e*) Mean area of cross section, square inch.
(*f*) Mean gas temperature, deg. Cent. absolute.
(*g*) Difference between gas and wall temperature, deg. Cent.
(*h*) Mean value of K.
(*i*) Velocity at end of section, feet per second.

From these the following items were calculated for each section :—

(*j*) Mean value of heat transmission from equation (1), C.H.U. per square foot per second.
(*k*) Total heat transmitted to cooling water, C.H.U. per second, *i.e.*, (*j*) × (*d*).
(*l*) Kinetic energy generated expressed as C.H.U. per second.
(*m*) Heat loss, per cent., *i.e.*, (*k*)/(*l*) × 100.

Owing to the peculiar shape of some of the curves obtained when (*j*), (*k*), (*l*) and (*m*) were plotted, a number of sections in the neighbourhood of the throat were further subdivided and the above items calculated separately. Owing to the varying lengths of these sections it was necessary to reduce (*k*) and (*l*) to a common basis and that selected for plotting in Fig. 2 is as follows :—

(*n*) Heat transmitted to cooling water, C.H.U. per second per 0·1in. length of nozzle.
(*o*) Kinetic energy generated, C.H.U. per second per 0·1in. length of nozzle.

Referring to Fig. 2, it would appear that the rate of heat transmission to the cooling water per square foot per second increases rapidly at first, until the throat of the nozzle is reached. After this the rate falls off gradually as the outlet of the nozzle is approached. The final rate is approximately one-third of the maximum.

The curve giving the heat lost per second per unit length of nozzle shows some alteration in the earlier portion owing to the convergence of the nozzle, but falls off much in the same manner as the one already noticed, although the commencement is a little earlier.

The rate, per unit length, at which kinetic energy is being generated in the nozzle, after a preliminary minimum, rises rapidly to a maximum, which occurs at the throat of the nozzle. This is followed by a very sharp falling off for about 0·1in., when the curve again changes its direction and falls much more gradually. The curve showing the percentage heat loss at any point along the nozzle axis exhibits the peculiarities of the curves already noticed. The loss is at first considerable, but falls rapidly to a minimum at the throat. After a slight increase the loss remains practically constant until the gas leaves the nozzle. The maximum loss is just over 10 per cent., and the minimum 2·4 per cent. From planimetric measurements the total loss is approximately 5 per cent. of the kinetic energy theoretically generated.

This method of treatment does not take into consideration the fact that the kinetic energy at the end of each section is lowered by an amount determined by the heat loss or by friction, but as the example was worked out to provide a rough idea only of the probable magnitude of the heat loss under these conditions, these and the many other objections which may legitimately be raised may, for the present, be passed over.

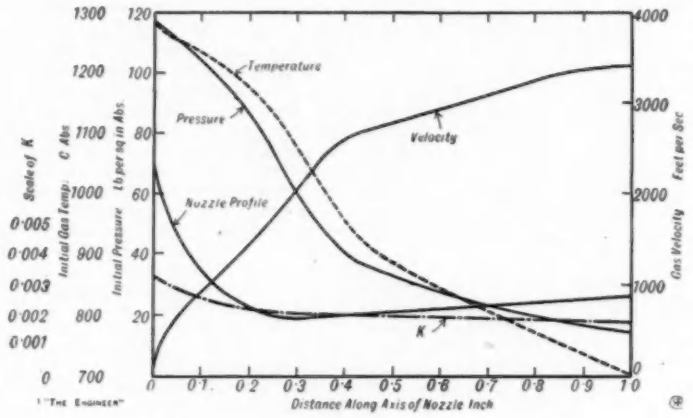


FIG. 1

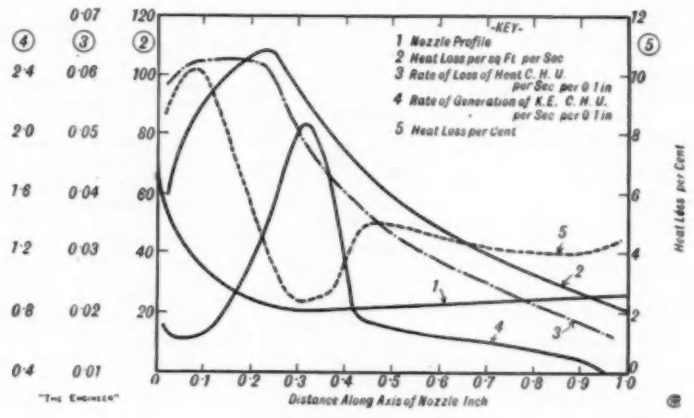

-KEY-
1 Nozzle Profile
2 Heat Loss per sq Ft per Sec
3 Rate of Loss of Heat C. H. U. per Sec per 0·1 in
4 Rate of Generation of K.E. C. H. U. per Sec per 0·1 in
5 Heat Loss per Cent
Heat Loss per Cent
Distance Along Axis of Nozzle Inch
"The Engineer"

FIG. 2

Some Experiments on Heat Loss from Nozzles.

Some experiments confirming the occurrence of heat losses of the above-mentioned magnitude, when high-temperature gases are expanded in water-cooled nozzles, were recently published by the writer,[7] and the reason for referring to the matter again is that on the former occasion space considerations prevented more than the very briefest reference to the question under discussion.

The method of holding these nozzles in the steel plate which formed the end of the combustion chamber is shown in Fig. 3. Two nozzles were used,

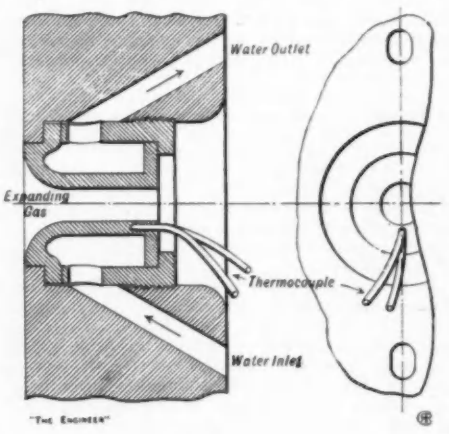


FIG. 3

the one being convergent-divergent, and the other convergent-parallel.

The throat diameter was ¼in. and the total length was 1in. in each case. Similarly, the converging portion of both nozzles was formed by the revolution of an arc of a circle $\frac{1}{16}$in. diameter about the nozzle axis as shown. The outlet diameters were $\frac{1}{16}$in. and ¼in. respectively. The temperature of the nozzle was measured by a silver-constantan couple soldered as shown and calibrated in position.

The heat loss was determined by measuring the quantity and temperature rise of the water cooling the nozzle. It was estimated that 87·5 per cent. of this passed into the water through the nozzle walls, the remainder being received in an axial direction from the furnace and through the plate which held the nozzle in position. The figures given in this article are those of the heat estimated to pass through the nozzle walls only.

The kinetic energy which could theoretically be generated in the nozzle per second was calculated from a knowledge of the initial temperature and composition of the expanding gas and of the pressure drop.

The fundamental data obtained from the experiments in question have already been given in the paper[7] referred to, but those relating to heat loss may, for the present purpose, be much more conveniently presented by Figs. 4 and 5, which indicate immediately the actual measured heat loss calculated as a percentage of the energy theoretically available, for combustion chamber pressures up to 100 lb. per square inch gauge. While the full lines in the figures have been drawn to represent the experimental points as far as possible, they have also been positioned so that the fixed relationships between initial gas pressures and temperatures, and the abscissa scale of energy, are closely satisfied. These relationships were previously determined by plotting the kinetic energy on a base of initial temperature for different initial pressures, and the points so obtained were transferred to Figs. 4 and 5.

It may be pointed out that the energy theoretically available for each experiment was calculated on the assumption that the specific heats[8] of the gas increase with temperature according to a linear law, which is sufficiently accurate over the range of temperature covered. The variation in composition of the expanding gas was also taken into account in each experiment. The initial gas temperature before expansion was determined by a platinum-platinum-rhodium thermo-couple placed in the combustion chamber along the nozzle axis and at a distance of ¾in. from the nozzle entrance. The pressure in the combustion chamber was measured by a specially calibrated Bourdon gauge.

In view of possible errors of observation and of wrong assumptions, the disposition of the experimental points is very satisfactory.

Throughout these experiments the weight of water cooling the nozzle was approximately constant at 0·1 lb. per second. As a result the nozzle temperature was not constant, but increased as the initial gas temperature increased. With the convergent-divergent nozzle the maximum temperature reached was 122 deg. Cent., but with the convergent-parallel nozzle it reached 180 deg. Cent. It was originally intended that the nozzle temperature should be kept constant throughout by varying the water flow, but this was rendered impossible by experimental difficulties. In Figs. 4 and 5, therefore, no correction has been applied to allow for the varying temperatures of the nozzle.

In order to obtain some information on the effect of nozzle temperature upon heat loss a few experiments were made upon the convergent-parallel nozzle, and although these are not sufficiently comprehensive to enable the exact influence of the nozzle temperature to be expressed numerically, they are interesting as showing general tendencies.

Two series of experiments were made at combustion chamber pressures of 40 lb. and 80 lb. per square inch gauge respectively. As those at the lower pressure seem less consistent than those at the higher, the latter only will be dealt with here, though both series obey the same general laws.

Experiments were made at each pressure with three different rates of water flow, the temperature in the combustion chamber being varied so that the values of nozzle temperature and heat loss could be determined for different gas temperatures. A few experiments were also made on both nozzles when expanding air initially at atmospheric temperature, the nozzle being at atmospheric temperature also. As far as could be determined, no heat was gained or lost by the water under these circumstances.

Fig. 6 gives the results of an analysis of these experiments, but owing to the fact that only three points on each curve are available, the positions and slopes of the latter cannot be drawn with any certainty. Roughly, the heat loss may be reduced by 1 per cent. at a combustion chamber pressure of 80 lb. per square inch gauge, by increasing the temperature of the nozzle by about 15 deg. Cent., independently of the temperature of the gas. It would appear also that if the nozzle can be maintained at a temperature of about 260 deg. Cent. there will be no

heat interchange between the gas and the nozzle wall if the temperature of the gas entering the nozzle is 1000 deg. Cent. This, however, does not seem feasible, for if it were so, the factor $(T - t)$ of equation (1) would be of considerable magnitude for any point along the nozzle wall. By reducing the temperature of the nozzle to 150 deg. Cent. it appears that about 10 per cent. of the heat initially in the gas will be carried away by the cooling fluid, for an initial gas temperature of 1000 deg. Cent., the loss thus increasing rapidly as the temperature of the nozzle is reduced. Although the values of the heat loss appear, therefore, to be reasonable at low nozzle temperatures, the slope of the lines drawn to represent the results seems too steep.

During the last experiment, when the rate of flow of water was cut down to a minimum to obtain the highest nozzle temperature possible, the temperature of the water leaving the nozzle was about 80 deg. Cent. If experience shows that it is possible to work with higher nozzle temperatures without experiencing difficulty from oxidation and erosion of the nozzle wall, and it is still desired to circulate a cooling fluid to take care of any local overheating, it will be necessary to use a liquid other than water, or to use much thicker nozzle walls.

The experiments were of too short duration to afford any definite information regarding the life of the nozzles under these working conditions, even though they were made of soft materials—the convergent-divergent nozzle of mild steel and the other of brass—with a view to accelerating the deleterious effects of the rapidly moving oxidising gas.

The convergent-divergent nozzle was expanding high-temperature gases for approximately 100 hours, and the convergent-parallel nozzle for approximately 50 hours. At the conclusion the interior surfaces had a frosted effect instead of being polished, but measurements indicated that the increase in throat diameter was a little less than 0·001in. in each case.

Comparative Experiments on Reciprocating Engines.

The loss of heat to the nozzle during the expansion of a gas in an internal combustion turbine finds a parallel in the jacket loss which occurs during the expansion stroke of an internal combustion piston engine. The latter quantity cannot be measured directly owing to experimental difficulties and can only be estimated by indirect methods. One such method was evolved by Dugald Clerk.[9] The quantity was calculated approximately by Clerk from his "zigzag" indicator diagram experiments, and varies for different engines running under different conditions. For a National gas engine, 14in. bore and 22in. stroke, running at 160 revolutions per minute, giving an expansion time of 0·1875 second, the heat flow during the explosion and expansion stroke, expressed as a percentage of the total heat input, was calculated by Clerk to be, for three experiments, 15·4, 17·0 and 16·0 respectively.

As a result of more detailed analysis Clerk concluded that about 60 per cent. of the loss takes place during the first three-tenths of the stroke. In another case about 50 per cent. was lost during the same fraction of the stroke. He adds: "These experiments prove conclusively that cooling behind a moving piston depends largely on the temperature of the water jacket, and still more upon the varying mean temperature of the cylinder walls according to the conditions of load and water circulation."

General Considerations.

It is evident, therefore, from estimates based upon equations derived from simpler experiments, from actual nozzle experiments, and from analogous experiments and calculations on internal combustion piston engines, that any effective form of cooling of the nozzle wall, and water cooling in particular, is likely to result in the removal of a considerable percentage of the heat initially in the working fluid before expansion.

The possible effects of this heat loss upon the state of the gas leaving the nozzle are interesting. When loss of heat to the nozzle wall is suppressed, as occurs with steam nozzles generally, the temperature after expansion is higher than it theoretically should be, owing to frictional reheat. At the same time, the velocity generated is reduced proportionately. The results are more complicated, however, when a heat loss through the nozzle is superimposed. One of two things may occur. First, it may so happen that the heat abstracted will be about equivalent to the heat generated by friction and the temperature drop of the gas during expansion may be approximately equal to the theoretical drop. In other words, the gas velocity may be determined by frictional losses and not by heat losses, the latter merely removing the surplus heat generated by friction. Secondly, the velocity theoretically possible may be lowered both by heat losses and by friction, and although the temperature after expansion may be the same as in the first case considered, the velocity generated might be further lowered. These points can only be elucidated by experiments, and those forming the basis of this article are unfortunately not sufficiently comprehensive to satisfy this want.

The temperature difficulty with internal combustion turbines has given prominence to many methods directed towards reducing the temperatures of the cycle with as little detriment as possible to the overall efficiency. If it happens that it is possible to abstract heat from the gas without affecting the velocity, up to a certain point, on the lines suggested above, then indeed may a heat loss be for once somewhat of a blessing! The strength of the wheel and blades, and consequently the speed at which they may be run, is dependent upon the temperature of the surrounding gas, and it is necessary that this shall be kept below a certain maximum. Furthermore, frictional reheat serves no useful purpose whatever in the internal combustion turbine using a perfect gas, and having few stages in its expansion. But while this heat loss may result in improved blading efficiency, it must not be overlooked that heat so removed during expansion is generated in the combustion chamber to do no useful work, and it is extremely doubtful whether the improvement in blade efficiency will compensate for the earlier loss in furnace and nozzle efficiency.

This, however, is the brighter side of the picture, for if the second case outlined above is found to obtain, heat leakage through the nozzle walls cannot but lower the overall efficiency of the cycle.

That a heat loss of considerable magnitude will occur if water cooling is adopted has been amply demonstrated, and there is little doubt that such loss of heat is detrimental to the overall efficiency of the turbine. The possible overall efficiency obtainable with the limits of pressure and of temperature dictated by compressor design, and by the strength at elevated temperatures of the materials employed, is not high. The internal combustion turbine cannot be a success unless the many parasitic losses can be cut down to a minimum.

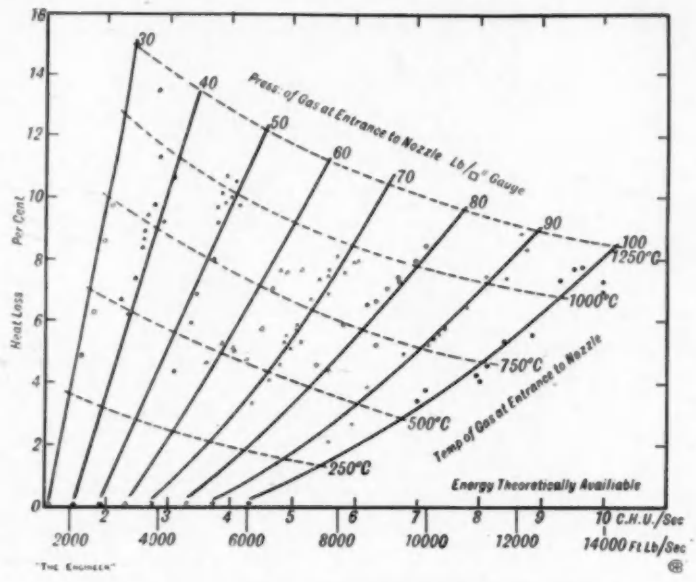


FIG. 4—HEAT LOSS IN CONVERGENT-DIVERGENT NOZZLE

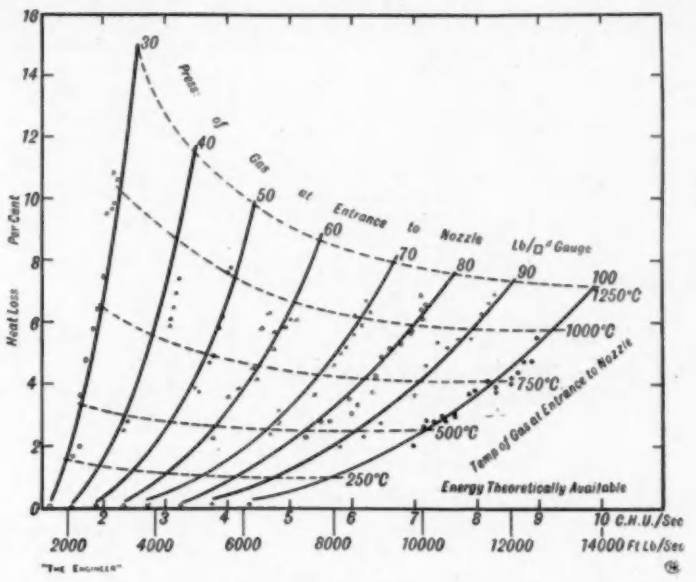


FIG. 5—HEAT LOSS IN CONVERGENT-PARALLEL NOZZLE

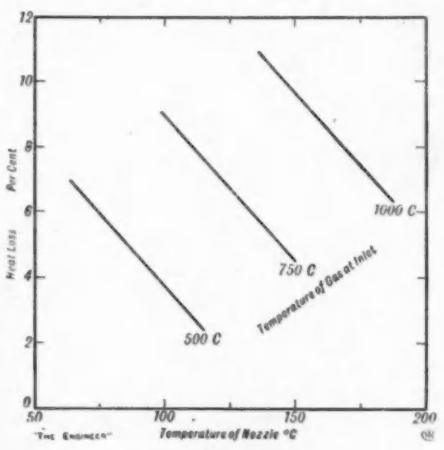


FIG. 6

Nozzle Materials Available.

Drastic cooling of the nozzle cannot, therefore, be seriously considered. The only course open is to employ a material possessing strength at high temperatures, together with very considerable powers of resistance towards erosion and to the attack of the high-temperature oxidising gases. Furthermore, even nozzles of such material must give satisfaction when effectively heat insulated from the turbine casing.

Many interesting suggestions have been put forward from time to time regarding the materials which might prove satisfactory. Some of these suggestions have resulted from a desire to reduce the erosion and corrosion of the nozzle walls, some evince a desire for novelty, but very few make the suppression of the heat loss their main object. In most of the turbines constructed, and of which details of performance are available, the material employed for the nozzles is not stated, but as in some instances little attention was given to selecting the best profile, it is hardly to be expected that the less obvious question of heat loss should claim much attention.

Stern,[10] in his suggested turbine for aircraft, working on the constant-pressure cycle, recommended cast iron, but gave no indication as to whether or not the nozzle should be water cooled.

Tungsten[11] has also been suggested as a suitable material, could it be obtained in bulk, on account of its high melting point and tensile strength, but it is very unlikely to be used on account of its cost and susceptibility to oxidation at comparatively low temperatures. While this latter objection does not apply to platinum, which at one stage in internal combustion turbine development was seriously put forward, cost again is the eliminating factor.

An interesting possibility is that of employing refractory materials in the construction of nozzles. As long ago as 1907, Batho[12] employed porcelain nozzles in a series of experiments on the temperature gradient existing in steam during its expansion in a convergent-divergent nozzle. His conclusion was that the material was unsatisfactory and that the heat leakage through the nozzle wall was very small. Stern[10] also stated that experiments with porcelain nozzles had not given satisfactory results, but gave no details. The manufacture of such nozzles is fairly simple, but accuracy of dimensions cannot be guaranteed without subsequent working. If this is carried out a smooth surface cannot be imparted to the nozzle.

More recently, fused quartz has become available, and could undoubtedly be formed, without great trouble, to the requisite shape and size. The surface finish is excellent and the material so hard and heat-resistant that scaling and erosion would be absent. The only disadvantage is its brittleness, and this,

possibly, may set a definite limit to its utility in this direction. It seems, however, that the material would be well worthy of a trial.

Finally, there is the group of heat-resisting alloys developed during the last dozen or so years which possess qualities markedly in advance of anything previously attainable with ferrous alloys. Their properties have been so frequently commented upon that it is unnecessary to refer to any specific examples.

CONCLUSION.

In concluding, it may be observed that the problems of the nozzle, when they do arise, will always be serious and important items in the evolution of the internal combustion turbine. With regard to the heat leakage dealt with in this article, there is fortunately every indication that considerable progress is being made in the production of suitable heat-resisting materials for the nozzle, and this must be looked upon as satisfactory, even though little direct progress is being made in the practical development of the internal combustion turbine itself.

[1] THE ENGINEER, Vol. CXXXV., No. 3518, June 1st, 1923.
[2] *Engineering*, December 27th, 1920, p. 802.
[3] "Proc.," Inst. Mech. Eng., 1909, p. 1317.
[4] *Engineering*, August 20th, 1920, p. 265.
[5] "Proc.," Inst. Mech. Eng., October, 1914.
[6] "Proc.," Royal Society, A. LXXX., 114, 1907.
[7] "Proc.," Inst. Mech. Eng., No. 2, 1928, p. 405.
[8] Values taken from "The Specific Heats of Gases," Partington and Shilling.
[9] See "The Gas, Oil and Petrol Engine," Part I.
[10] Aeronautical Research Committee. Engine Sub-committee Report, No. 54.
[11] *Engineering*, Vol. CXI., No. 2882, March 25th, 1921.
[12] "Proc.," I.C.E., Vol. CLXXIV., 1908, p. 317.

The New Holland-America Liner Statendam.

No. II. (*conclusion*).*

In our preceding article we described the design of the hull and propelling machinery of the "Statendam," and gave some particulars of her passenger accommodation, and of her safety and navigating equipments. In connection with the fire protection devices, we may say that, in addition to the Rich smoke detectors and fire-extinguishing apparatus, a complete Foamite equipment is installed in the boiler-rooms, and additional portable extinguishers of this type are also carried. To-day we deal principally with the engine-room auxiliary machinery and the steam and feed connections. The metric figures given in this article, together with the diagram of the feed circuit, are taken from a paper read on May 10th last before the Royal Institution of Engineers in Holland by Dr. W. M. Meijer, the Chief Superintendent of the Holland-America Line. This paper will be published in the "Proceedings" of that Institution in due course.

MAIN PROPELLING AND AUXILIARY MACHINERY.

It will be recalled from our first article that the "Statendam" is propelled by twin-screw single-reduction geared turbine machinery, designed to operate at 400 lb. pressure with a steam temperature of 650 deg. Fah. The six boilers are of the Babcock and Wilcox water-tube type and are oil fired on the "White" system. Solid forged drums are used and the position of the superheater is somewhat lower than that of the normal pattern of boiler on account of the high temperature at which the steam has to be delivered.

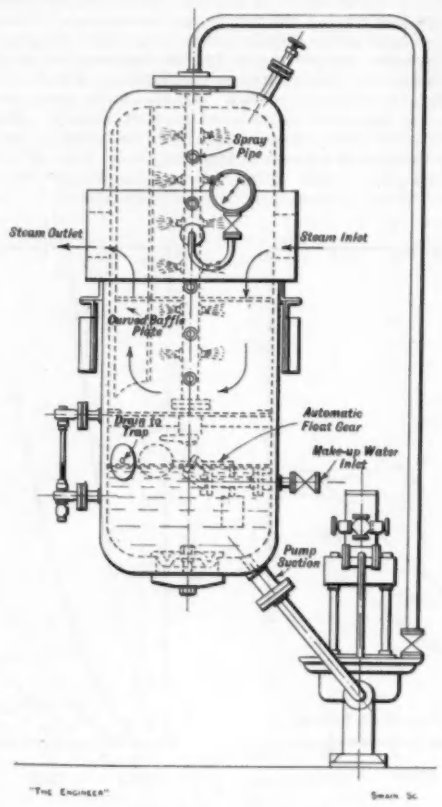


FIG. 1—DE-SUPERHEATER

Each boiler must provide steam for 4000 S.H.P., so that in service five boilers are in operation and one is a stand-by unit. The air heaters are designed to raise the temperature of the combustion air to 347 deg. Fah. All the steam produced by the boilers passes through the superheaters, and saturated steam is obtained as required by passing boiler steam through two specially designed de-superheaters working along with reducing valves. A section through one of these is shown in Fig. 1. The purpose of these de-superheaters is to provide saturated steam to the feed heaters and other services which are normally operated by steam bled from the main turbines. Whilst manœuvring, this source of supply is not available, and the de-superheaters are then brought into action. Each of them consists of a seamless steel casing, in which water, taken from the delivery side of the main feed pumps, is maintained at a constant level by a float and valve. This water is drawn up by a circulating pump, and is delivered as a fine spray into the upper part of the vessel. Steam enters on the right and after saturation by the spray leaves on the left. In a very short time the water at the bottom of the vessel reaches saturation temperature.

The condensers are of the "Weir" underslung regenerative type, with "Allen" electrically driven centrifugal circulating pumps. Each of these pumps, of which there are four, has a 19in. branch and a designed output of 6500 gallons of water per minute against a head of 28ft. They are driven by 80 B.H.P. variable-speed motors with contactor control gear fitted on the unit. Other Allen pumps include the auxiliary circulating, sanitary, and oil-cooling pumps, all of which are electrically driven. The two air pumps are of the "Weir-Paragon" pattern, and are also motor driven. Each of them has two chambers, with a bore of 19in. and a stroke of 13in., and vacuum augmenter ejectors with condensers are fitted. They are designed to deal with 75,270 lb. of condensate per hour, when running at 80 r.p.m., with a designed vacuum of 95 per cent. corresponding to about 28·94in. under working conditions.

The main feed pumps are four in number and of the "Weir" direct-acting type, having a 12½in. pump cylinder and a 24in. steam cylinder, with a stroke of 28in. Each pump when making eight double strokes per minute will deliver 10,000 gallons of water per hour against a pressure of 470 lb. per square inch when supplied with steam at 250 lb. gauge pressure and when exhausting against a back pressure of 89 lb. per square inch abs. There are two multiflow surface type feed-water heaters for low and high pressures; the former has a surface of 534 square feet, and is designed to raise the temperature of 200,000 lb. of feed water per hour from 120 deg. to 175 deg. Fah. when supplied with 11,800 lb. of steam per hour at a pressure of 10·8 lb. per square inch abs. This heater has also to raise the temperature of the same amount of water from 120 deg. up to 260 deg. Fah. when it is supplied with 30,000 lb. of steam per hour at a pressure of 89 lb. per square inch abs. The high-pressure heater is of the same type with a surface of 750 square feet, and is designed to heat 200,000 lb. of feed water per hour from 175 deg. to 300 deg. Fah. when supplied with 26,500 lb. of steam at a pressure of 89 lb. per square inch abs.

Each of the vertical evaporators, of which there are two, has a surface of 132 square feet and an output of 70 tons of vapour per twenty-four hours. They are supplied with steam at 89 lb. per square inch abs., and the vapour produced is led to the low-pressure bled steam main at 10·8 lb. per square inch abs., or it can be passed at atmospheric pressure to the distiller condenser. This condenser has 300 square feet of surface, and its designed duty is to condense 140 tons of vapour per twenty-four hours when supplied with 35,000 gallons of circulating water per hour at an inlet temperature of 65 deg. Fah. Other Weir pumps include electrically driven units for the oil transfer, fresh water, lubrication, circulating water and auxiliary boiler feed services. In the feed tank—see Fig. 2—there is an automatic float gear and a 4in. balanced steam valve, which regulates the supply of steam to the evaporators, according to the water level within the feed tank.

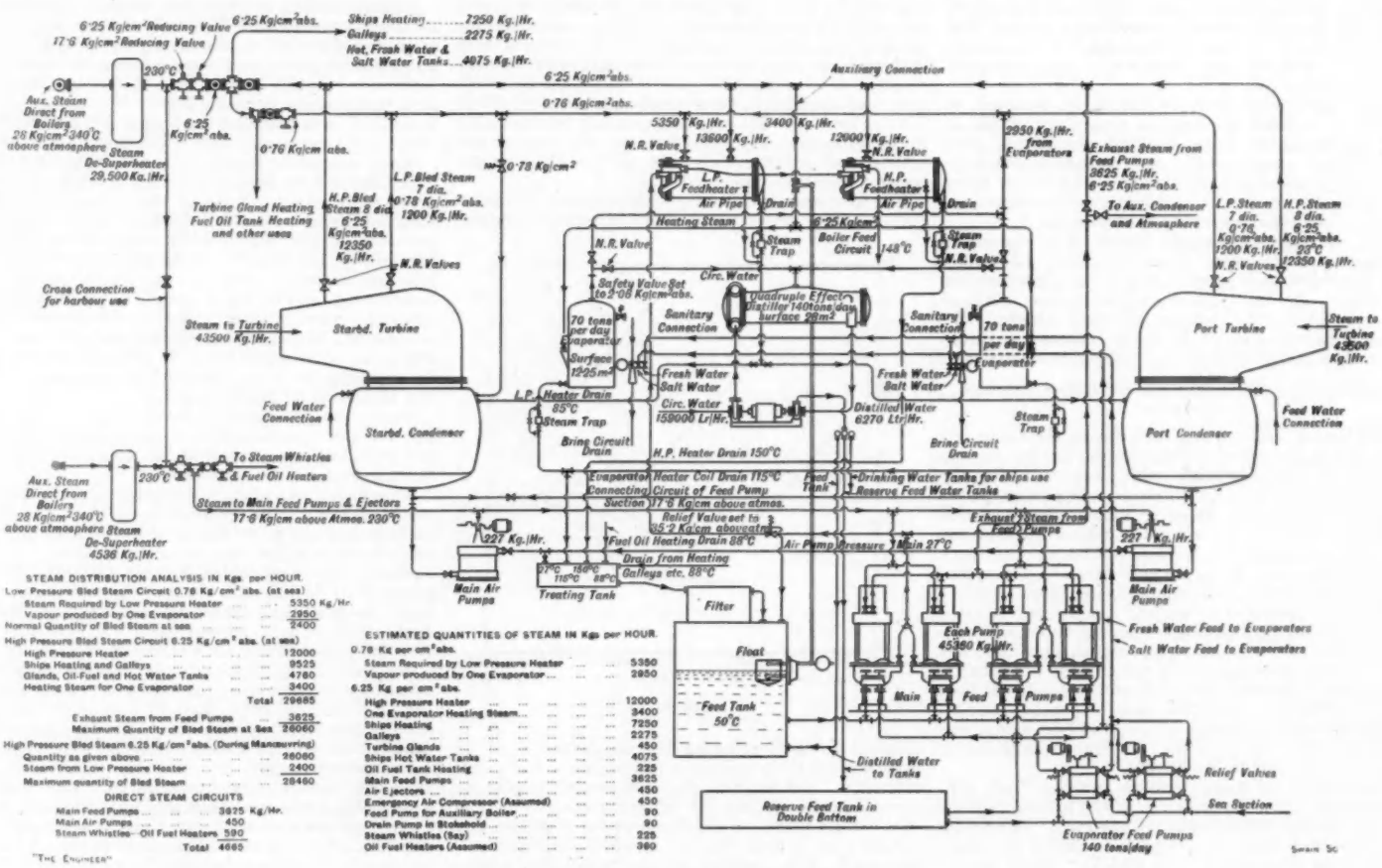

6·25 Kg/cm² Reducing Valve
17·6 Kg/cm² Reducing Valve
6·25 Kg/cm² abs.
Ships Heating ..... 7250 Kg./Hr.
Galleys ..... 2275 Kg./Hr.
Hot, Fresh Water & Salt Water Tanks ... 4075 Kg./Hr.
230°C
Aux. Steam Direct from Boilers 28 Kg/cm² 340°C above atmosphere
Steam De-Superheater 29,500 Kg./Hr.
6·25 Kg/cm² abs.
0·76 Kg/cm² abs.
Auxiliary Connection
0·76 Kg/cm² abs.
5350 Kg./Hr.
13600 Kg./Hr.
3400 Kg./Hr.
12000 Kg./Hr.
N.R. Valve
2950 Kg./Hr. from Evaporators
Exhaust Steam from Feed Pumps 3625 Kg./Hr. 6·25 Kg/cm² abs.
To Aux. Condenser and Atmosphere
Turbine Gland Heating, Fuel Oil Tank Heating and other uses
H.P. Bled Steam 8 dia. 6·25 Kg/cm² abs. 12350 Kg./Hr.
L.P. Bled Steam 7 dia. 0·78 Kg/cm² abs. 1200 Kg./Hr.
0·78 Kg/cm²
L.P. Feedheater
H.P. Feedheater
Air Pipe
Drain
Heating Steam
Steam Trap
6·25 Kg/cm² Boiler Feed Circuit 148°C
L.P. Steam 7 dia. 0·76 Kg/cm² abs. 1200 Kg./Hr.
H.P. Steam 8 dia. 6·25 Kg/cm² abs. 228°C 12350 Kg./Hr.
Cross Connection for harbour use
Safety Valve Set to 2·08 Kg/cm² abs.
Circ. Water
Quadruple Effect Distiller 140 tons/day Surface 28m²
Sanitary Connection
70 tons per day Evaporator
Surface 1225m²
Steam to Turbine 43500 Kg./Hr.
Starbd. Turbine
Port Turbine
Fresh Water Salt Water
L.P. Heater Drain 85°C
Circ. Water 159000 Ltr./Hr.
Distilled Water 6270 Ltr./Hr.
Brine Circuit Drain
H.P. Heater Drain 150°C
Feed Water Connection
Starbd. Condenser
Port Condenser
To Steam Whistles & Fuel Oil Heaters
Steam to Main Feed Pumps & Ejectors 17·6 Kg/cm above Atmos. 230°C
Evaporator Heater Coil Drain 115°C
Connecting Circuit of Feed Pump
Suction 17·6 Kg/cm above atmos.
Relief Value set to 0·2 Kg/cm above atmos.
Feed Tank
Drinking Water Tanks for ships use
Reserve Feed Water Tanks
Exhaust Steam from Feed Pumps
227 Kg./Hr.
Fuel Oil Heating Drain 88°C
Air Pump Pressure Main 27°C
Drain from Heating
Galleys etc. 88°C
27°C 115°C 88°C
Treating Tank
Main Air Pumps
Filter
Float
Feed Tank 50°C
Each Pump 45360 Kg./Hr.
Main Feed Pumps
Fresh Water Feed to Evaporators
Salt Water Feed to Evaporators
Distilled Water to Tanks
Reserve Feed Tank in Double Bottom
Relief Valves
Sea Suction
Evaporator Feed Pumps 140 tons/day
STEAM DISTRIBUTION ANALYSIS IN Kgs. per HOUR.
Low Pressure Bled Steam Circuit 0.76 Kg/cm² abs. (at sea)
Steam Required by Low Pressure Heater ... 5350 Kg./Hr.
Vapour produced by One Evaporator ... 2950
Normal Quantity of Bled Steam at sea ... 2400
High Pressure Bled Steam Circuit 6.25 Kg/cm² abs. (at sea)
High Pressure Heater ... 12000
Ships Heating and Galleys ... 9525
Glands, Oil-Fuel and Hot Water Tanks ... 4780
Heating Steam for One Evaporator ... 3400
Total 29685
Exhaust Steam from Feed Pumps ... 3625
Maximum Quantity of Bled Steam at Sea 26060
High Pressure Bled Steam 6.25 Kg./cm² abs. (During Manœuvring)
Quantity as given above ... 26060
Steam from Low Pressure Heater ... 2400
Maximum quantity of Bled Steam ... 28460
DIRECT STEAM CIRCUITS
Main Feed Pumps ... 3625 Kg./Hr.
Main Air Pumps ... 450
Steam Whistles—Oil Fuel Heaters 590
Total 4665
ESTIMATED QUANTITIES OF STEAM IN Kgs per HOUR.
0.76 Kg. per cm² abs.
Steam Required by Low Pressure Heater ... 5350
Vapour produced by One Evaporator ... 2950
6.25 Kg. per cm² abs.
High Pressure Heater ... 12000
One Evaporator Heating Steam ... 3400
Ships Heating ... 7250
Galleys ... 2275
Turbine Glands ... 450
Ships Hot Water Tanks ... 4075
Oil Fuel Tank Heating ... 225
Main Feed Pumps ... 3625
Air Ejectors ... 450
Emergency Air Compressor (Assumed) ... 450
Feed Pump for Auxiliary Boiler ... 90
Drain Pump in Stokehold ... 90
Steam Whistles (Say) ... 225
Oil Fuel Heaters (Assumed) ... 360

FIG. 2—STEAM AND FEED-WATER CIRCUITS

MAIN PROPELLING AND AUXILIARY MACHINERY.

It will be recalled from our first article that the "Statendam" is propelled by twin-screw single-reduction geared turbine machinery, designed to operate at 400 lb. pressure

* No. I. appeared May 31st.

FEED WATER AND STEAM CIRCUITS.

In designing the machinery of the "Statendam" an effort was made to obtain the utmost economy with regard to the amount of heat expended, on the one hand for

main propelling and engine-room auxiliary purposes, and, on the other, to meet the various demands of the navigation, lighting, ventilating, food preparation, refrigerating, and cargo-handling services. As is well known, the main loss of heat in any steam cycle takes place in the condenser where the latent heat of evaporation is withdrawn from the operating steam and passes overboard with the circulating water. In the installation we are considering steam is generated at an initial pressure of 28 kilos. per square centimetre above atmosphere, and a total temperature of 350 deg. Cent. It is expanded to a pressure of 6·2 kilos. per square centimetre abs. in the high-pressure turbine and to 0·7 kilos. per square centimetre abs. in the low-pressure turbine, from which it exhausts to the condenser at a 95 per cent. vacuum. The heat content of this steam is 746 calories per kilogramme before expansion, and after expansion to the condenser it still has a heat content of 495 calories, so that allowing 20 calories for the heat content of the condensate, of the 746 calories originally present, no less than 475 are wasted in the circulating water. In order to minimise this loss as far as possible, the installation has been designed to utilise bled steam for feed-water heating, for supplying warmed air to the public rooms and cabins, and for the general domestic services of the vessel. With the exception of the feed pumps, all other auxiliary pumps and fans are electrically operated, the current for lighting and power purposes being supplied by four 400-kW Diesel engine driven generator sets.

The steam and feed-water circuits can be clearly followed from the diagram we reproduce in Fig. 2. On the left and right-hand sides there will be seen the two main turbines and condensers, from which tappings are taken to feed the 6·25 kilos. per square centimetre abs., and the 0·76 kilos. per square centimetre abs. bled steam circuits which are indicated at the top of the diagram. The four main feed pumps which work at a designed pressure of 17·5 kilos. per square centimetre above atmosphere and exhaust to the 6·25 kilos. per square centimetre circuit, which is otherwise supplied from the intermediate-pressure stage of the main turbines, are shown to the lower right-hand side of the diagram. The steam for the boiler feed pumps is taken through the de-superheaters and the reducing valves, and the condensate from the main condensers is slightly heated by the steam from the vacuum augmenters, so that it attains a final temperature of 26 deg. Cent. It is then delivered to the treating tank, where it is mixed with the drained condensates from the various circuits, and is further raised to 49 deg. Cent. From the feed pumps it is delivered through the low and high-pressure feed heaters, in which its temperature is increased to 80 deg. and to 150 deg. Cent. respectively, this being the temperature at which it is supplied to the boilers. Steam traps are fitted on the heating steam sides of both feed heaters, and the condensate so derived passes from the high-pressure heater to the treating tank, while that from the low-pressure heater is delivered to the main condensers. At the top of the diagram the feed heater steam circuits are shown, as are also those for the evaporators and the ship's heating, galleys, and sanitary hot water supplies.

The two bled steam circuits are designed to be maintained at a constant pressure, whilst the main turbines are operating under full-power conditions, that is at maximum heat economy. When manœuvring, however, arrangements are made, previously referred to, for taking steam direct from the boilers through the de-superheaters and reducing valves. Safety valves are fitted in both the heating circuits to protect them from damage in the event of a possible failure of one of the reducing valves. When the turbines are shut off from the heating system any desired manœuvres can be carried out without interfering with the working of that system, and when the turbines are again put upon full power the normal supply of bled steam is reinstated.

Calculated Heat Economy.

In Fig. 2, at the foot of the diagram, a calculated analysis of the steam distribution in kilogrammes per hour is given along with the estimated quantities of steam required in actual service. If we assume a total heat of 746 calories per kilogramme at the beginning, the following amounts of heat regained in the various circuits per kilogramme of steam are obtained :—

	Calories.
Low-pressure feed water heater	31
High-pressure feed water heater	70
Drain from evaporator heating coils	4·35
Drain from high-pressure feed heater, oil fuel heaters and steam led to vacuum augmenter including heat present in the feed water when leaving the condenser	19·24
Drain from galleys, ship's heating and sanitary hot water tanks	13·20
	137·79

Thus in every cycle there requires to be added per kilogramme of steam 746 — 137·79 calories, or 608·2 calories. If the efficiency of the boilers is taken as 87 per cent. and the higher calorific value of the fuel at 10,555 calories per kilogramme, the fuel consumption per kilogramme of steam produced works out at 0·0662 kilos. of oil, corresponding to a 15·1 to 1 evaporation ratio. For every kilogramme of steam produced by the boilers 0·9552 kilos. is led to the high-pressure turbine, the remainder going to the feed pumps and the vacuum augmenter. Further, of this 0·9552 kilos. an amount of 0·2905 kilos. is bled for high-pressure feed heating and for the evaporators, galleys, &c., so that only 0·6447 kilos. enters the intermediate pressure turbine. After passing through this turbine 0·365 kilos. is again bled off, so that only 0·6286 kilos. reaches the low-pressure turbine and passes to the condenser. This being so, only 63 per cent. of the steam reaches the condenser, and of the remaining 27 per cent. the latent heat of evaporation is either completely regained or is usefully expended in heating the ship and performing other domestic services.

For every kilogramme of steam produced by the boilers there is available for power production in the main engines the following fractions :—In the high-pressure turbine, 0·9552 kilos.; in the intermediate-pressure turbine, 0·6647 kilos.; and in the low-pressure turbine, 0·6282 kilos. Further, the internal heat drop of this steam amounts to 85 calories between the high-pressure turbine supply and exhaust; to 84 calories between the intermediate-pressure turbine supply and exhaust; and to 82 calories between the low-pressure turbine supply and exhaust. There is therefore available for every kilogramme of steam produced 81·19 calories in the high-pressure turbine, 55·83 calories in the intermediate-pressure turbine, and 51·51 calories in the low-pressure turbine, giving a total of 188·53 calories available for power production. If now the mean thermodynamic efficiency of the turbines is taken at 83 per cent., in order to produce one shaft horse-power 4·04 kilos. of steam will be required, and with the calculated 15·1 to 1 ratio of evaporation 268 grammes of oil fuel. If an output of 20,000 shaft horse-power be assumed, this gives a fuel consumption of 5·36 metric tons per hour, or 128·6 tons per day of twenty-four hours. If now to this quantity there be added the fuel consumption of the Diesel generator sets, which may be taken as 7 tons per day, the total consumption for all purposes works out at 135·6 metric tons of oil per day, corresponding to 282·5 grammes of oil fuel per shaft horse-power hour.

On the trials of the ship and during her first voyage a daily consumption of 146·3 metric tons of oil fuel and 7 tons of Diesel oil was recorded for an output of 22,140 shaft horse-power. The fuel oil used had a calorific value of 10,260 calories per kilogramme, which is low, and the consumption corrected for 10,555 calorific value of oil works out at 142·2 metric tons per day, or, including the Diesel oil, 149·2 tons, corresponding to 280·7 grammes of oil per shaft horse-power for all purposes. This value is very close indeed to the calculated figure of 282·5 grammes given above.

We have seen that for each kilogramme of steam at every cycle an amount of heat equal to 608·2 calories must be added, and also that per kilogramme of steam for power production in the turbines 188·53 calories are available, which, taking a thermodynamic efficiency of 83 per cent. gives an amount of energy equal to the equivalent of 0·83 × 188·53, or 155 calories. With an 87 per cent. boiler efficiency the 608·2 calories which have to be added are equal to 699 calories of fuel. Thus for every 699 calories of fuel 155 calories effective power is obtained at the shaft, giving an efficiency for the complete installation of 22·2 per cent. If now the energy required for producing propelling power, along with its auxiliary requirements for other purposes, be taken into account, the following figures are obtained :—For ship's heating, 45·84 calories; for sanitary hot water, 25·78 calories; for galleys and pantries, 14·33 calories; giving a total of 85·95, or, say, 86 calories. The efficiency of the installation can also be arrived at in the following way. For every kilogramme of steam there are added 699 calories of fuel, and for every kilogramme of steam 86 calories are usefully expended in domestic services, giving a difference of 613 calories. Of this remaining 613 calories 155 calories of effective propulsive energy is produced, which corresponds to an efficiency of 25·3 per cent. It should be pointed, however, that in making these last two efficiency calculations the consumption of the oil engine-driven generators has not been taken into account. In so far as the electrical energy supplied by the generators is used for purposes which do not directly apply to the ship's domestic services, the corresponding fuel consumption expressed in calories and taken for 1 kilo. of steam consumption should be added to the calculated heat in calories required per kilogramme of steam. If this is done, the percentage efficiencies above given are slightly reduced, but at the moment correct measurements of the energy distribution in the different electric circuits are not available, so that the exact correction cannot be made.

Justifiable pride is felt by the Holland-America Line, the owners of the "Statendam," and by Wilton's Engineering and Slipway Company, of Rotterdam, on the completion of a ship which is believed to be the most economical liner afloat. The hull of the "Statendam" was towed from Harland and Wolff's Belfast yard in April, 1927, and arrived at Wilton's new Schiedam yard on April 20th. About two years later, the completed liner ready for sea left Rotterdam for her technical trials. After a successful maiden voyage she is now returning from New York to Rotterdam on her second round trip. We would express our indebtedness to Dr. W. M. Meijer, who has placed at our disposal the particulars given in these articles, and we would congratulate him on the honour of the rank of Officer of the Order of Orange-Nassau, lately conferred upon him by the Queen of the Netherlands in recognition of the work he has done in connection with this ship.

The Institution of Civil Engineers.

APRIL EXAMINATIONS, 1929.—PASS LIST (*INTERIM*).

(Subject to confirmation by the Council.)

PRELIMINARY (108)

The results of the Examination held abroad will be announced later.

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Section A only (54).—W. G. MacD. Anderson, A. L. Archibald, F. Bardsley, E. S. Benson, R. F. C. Booth, H. R. Bridger, H. G. Buxton, D. M. Cannon, R. Carey, J. H. Contractor, H. C. Davey, R. W. Day, G. M. Dingwall, A. B. Duncan, L. Essayed, H. L. Folkes, J. B. Footner, A. C. U. Forrest, R. Forrester, D. Garden, J. A. Harper, G. B. Hayward, D. Y. Hill, E. L. Hogg, C. F. V. Lawton, W. F. Longfield, H. Longton, R. F. Lowe, I. MacK. MacLean, J. M. McLeod, D. McVean, W. K. Marples, G. A. Mather, J. Miller, C. Needham, jun., A. W. Nettleton, G. W. Roberts, J. D. Sharman, C. H. Smith, W. McC. Smith, V. E. Stanbridge, G. S. Standley, J. D. S. Stephen, J. A. Stirling, N. H. Stockley, T. S. Taylor, jun., J. A. Thomson, J. C. Thomson, E. J. Tonelli, L. G. Tucker, N. E. Westerhout, H. W. Wood, R. K. Wood, J. M. Wyllie.

Section B only (33).—W. C. N. Bosworth, J. B. R. Brooke, G. Butters, H. W. Cameron, F. H. Clough, T. Cooper, H. C. H. Crawley, C. C. Cunnold, M. N. Dalal, G. Downing, H. J. Eddie, G. C. N. Elliot, F. Everitt, J. Fletcher, A. H. Gillard, B. W. Hadfield, K. A. Haynes, H. S. Heath, A. Inglis, K. E. Langford, W. B. Lawson, J. E. Lee, A. Parker, J. H. A. Perkins, W. H. Pink, J. C. Russell, J. A. B. Scott, E. W. E. Simpson, J. G. Smith, J. N. Smith, W. E. Thorowgood, C. E. Watson, F. T. Wood.

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THE INSTITUTE OF METALS.—Owing to the great number of non-members of the Institute of Metals who are anxious to take part in the Düsseldorf meeting of the Institute, to be held on September 9th to 12th, the Council of the Institute will meet specially on July 4th to consider applications for membership of the Institute. Only members of the Institute will be able to take part in the various functions in connection with the Düsseldorf conference.

ASSOCIATION OF EX-SIEMENS' MEN.—On April 26th a meeting was held in London at which the Association of Ex-Siemens' Men was formed, and on Wednesday, May 29th, the first re-union dinner was held, with Mr. Frank Wallis (English Electric Company) in the chair. Some fifty members attended the dinner and concert, and a very enjoyable evening was spent. The Association is confined to ex-members of the Siemens' organisations and the qualification for membership is that applicants should have served at least one year on the staff of such organisations, the annual subscription being merely a nominal one. The hon. secretary is Mr. J. Snow Huddleston, Dagenham Dock, Essex, who would be pleased to give full particulars of the Association.

AN OIL FEEDER IMPROVEMENT.—We have received from Joseph Kaye and Sons, Ltd., Lock Works, Leeds, a sample half-pint seamless oil feeder fitted with a new and simple improvement whereby the flow of oil from the can may be regulated to suit the user's requirements. The can is provided with the familiar valve operated by a thumb button, whereby the passageway through the spout is opened and closed. The improvement consists of fitting a nut and a lock nut under the thumb button, which, as a consequence, can be regulated in its travel from the full normal value down to zero. In this way the user can set the feeder to deliver a flow of oil of any convenient amount. We are informed that Messrs. Kaye were recently asked to supply an oil feeder of this type as a sample, and that after the sample had been tested a large order was placed with them.

North-East Coast Exhibition.

No. IV.*

OUR description of the apparatus and machinery shown in the Palace of Engineering at the North-East Coast Exhibition is continued below.

MICHELL BEARINGS, LTD.

An exhibit of special interest to marine engineers is that of Michell Bearings, Ltd., of South Benwell, Newcastle-on-Tyne, which is shown in Fig. 32. It consists of two marine thrust blocks, one of which is fitted with the firm's patented thrust indicator, and one of the latest forms of Michell tunnel bearings.

The units are arranged in line, and are motor driven through a reduction gear, the shaft revolving at 50 r.p.m. The covers are lifted to expose the internal parts so that the general construction of the units and the distribution of oil to the pads can be clearly seen. In actual service the thrust block—see right-hand view in Fig. 32—is entirely enclosed. It contains its own oil supply in the pedestal, and provision is made for fitting a cooling coil, although this, we are informed, is seldom necessary. When standing, the oil is level with the bottom of the shaft, the lower part of the collar being submerged. As the shaft revolves surplus oil adhering to the collar is scraped off at the top centre and cascades into troughs at the sides which direct the flow to the thrust pads and also to the journals. The oil returns by gravity to the sump, and is again picked up by the collar, and so the natural circulation proceeds. By a simple oil-deflecting device all glands are abolished and the oil is prevented from escaping along the shaft at the ends of the bearing. The thrust pads themselves are carried in stiff horseshoes, and by removing a light cover all internal parts can be removed without disturbing the shaft. The whole of the thrust load is transmitted through the horseshoes to the lower half of the block, so that no stress is applied to the cover bolts.

When it is desired to register the actual thrust exerted by the propeller—see the centre view in Fig. 32—the forward horseshoe is replaced by one of forged steel containing four or more short rams. By means of a small hand-operated oil pump these rams press aft until the propeller load is balanced and registered on an ordinary pressure gauge. On the stand arrangements are made whereby a load of 250 lb. per square inch on the pad faces can be applied by means of a hand pump giving a total thrust load of approximately 20,000 lb. The bearing can be shown running under a thrust pressure of 8 tons. If desired the thrust can be recorded on a graph, which has been done in the P. and O. liner "Viceroy of India," and other recent vessels. The thrust indicator has been extensively used on board naval and merchant ships, and much valuable data have, and are being obtained.

The Michell tunnel bearing—shown to the left of Fig. 32—has been developed to overcome unsatisfactory conditions, which often obtain even in modern vessels and warships, when oil is led from the pressure system to each bearing and drained into a tank at the after end from which it has to be pumped back to the engine-room. In such installations the end glands which are usually fitted to retain oil in the bearings, may often become a source of anxiety as they may tend to score the shafts. The new tunnel bearing is self-contained, self-lubricating and oil-tight, and is considerably shorter and lighter than the usual tunnel bearing. Moreover, all external oil pipes and accessories are eliminated. The new bearings are manufactured both for naval and mercantile service, in sizes varying from 5in. to 22½in. diameter. They are being fitted to the new passenger liners which are now under construction for the Canadian Pacific Railway Company.

* No. III. appeared May 31st.

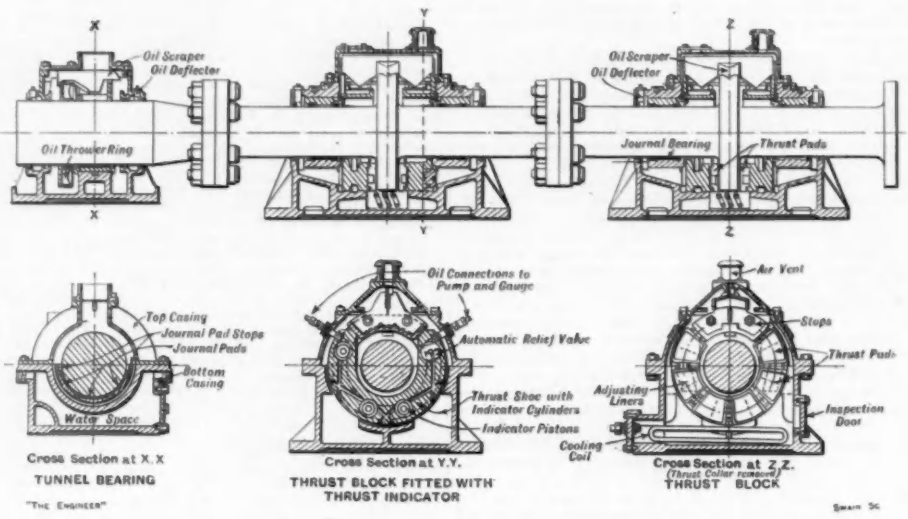


FIG. 32—TUNNEL BEARING AND THRUST BLOCKS—MICHELL

Slipper units and thrust rings of various sizes, both for land and marine work, are to be seen; also a thrust ring made in halves which has been specially designed for a combined reciprocating engine and exhaust steam turbine installations of the Bauer-Wach type, in which they are employed both for the turbine and the second reduction thrust bearings.

A. REYROLLE AND CO., LTD.

Metal-clad switch pillars with wide machined flanges which make the enclosure flameproof, are among the exhibits of A. Reyrolle and Co., Ltd., of Hebburn-on-Tyne. As shown in the illustrations, Figs. 33 and 34, these pillars consist of fixed and movable portions. The former contains only the insulated connections and the latter current transformer trip coils, and other apparatus that is likely to require overhaul or adjustment. In order to isolate the circuit breaker, it is simply necessary to pull the movable portion along the side bars to be seen in Fig. 33. The plug receptacles are then the only parts that are alive, and in order to avoid danger they are deeply recessed in porcelain insulators, and a door with a padlock is provided. Simple interlocking mechanism prevents incorrect operation, such as closing the switch before the movable portion is properly engaged, or plugging-in this portion of the gear before the switch is closed. These circuit breakers are made for pressures up to 3300 volts. The smaller types are capable of dealing with 100 ampères and the larger types 200 ampères.

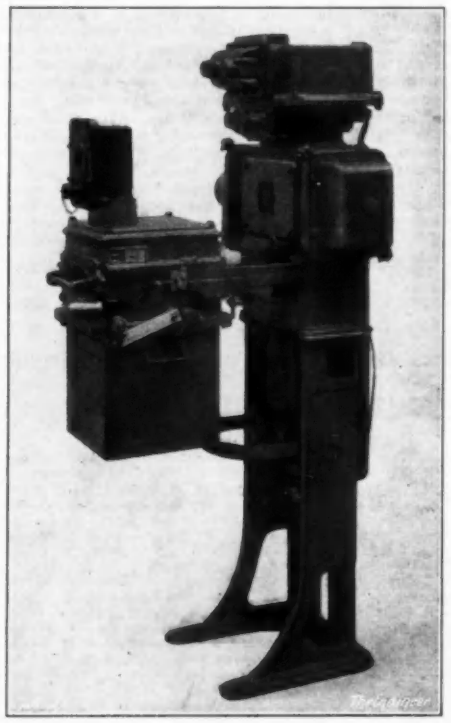


FIG. 33—FLAMEPROOF SWITCH PILLAR—REYROLLE

Two or three instantaneous overload trips can be provided, or, if desired, an adjustable time lag may be fitted. On top of the bus-bar chamber a potential transformer can be fixed, whilst the high-tension fuses are mounted on holders screwed into the casing. The action of unscrewing breaks the circuit to the transformer first, and further unscrewing is necessary before the holder can be withdrawn, thus ensuring that any sparking which may occur takes place in a closed casing, and in order to ensure that no flame can reach the atmosphere, use is made of a triple thread which considerably increases the area of the metal to metal contact. A circuit breaker of the type illustrated has been tested at the Sheffield University, and has been awarded a certificate which testifies that the switch is safe in an explosive atmosphere. Any number of these pillars may be mounted together to form a complete switchboard. The small oil-immersed flameproof circuit breaker, shown in Fig. 35, is another Reyrolle exhibit. Two examples of these breakers are shown, one for pillar or wall mounting, as illustrated, and the other for mounting on skids, so that it may easily be transferred from place to place. Like the mining metal-clad pillars shown in Figs. 33 and 34, these small oil-immersed circuit breakers have been tested at Sheffield University, and have been

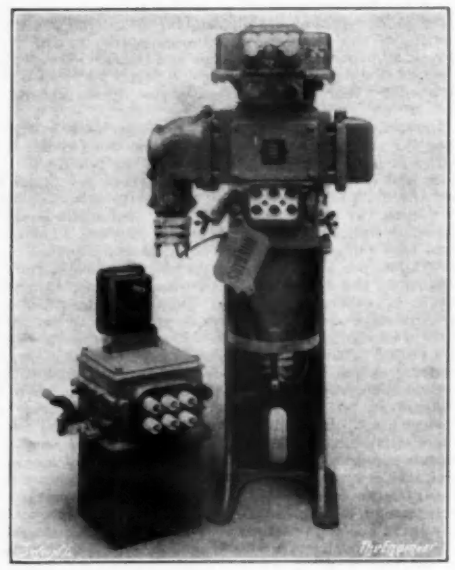


FIG. 34—PILLAR WITH SWITCH REMOVED—REYROLLE

awarded a certificate showing they are suitable for use in explosive atmospheres, and the design complies with all the regulations under the Coal Mines Act of 1911. Like the tanks of the switch pillars just described, those of these small oil-immersed circuit breakers are composed of welded boiler plate. Two or three series overload trip coils may be fitted, and either inverse time limit dashpots or tubes for instantaneous tripping may be provided, each adjustable to give a wide tripping range. When it is permissible to switch a squirrel-cage motor direct on to the line, a starting dashpot may be fitted, and arranged so that the operation of closing the circuit breaker lowers the trip coil plungers and prevents tripping as the result of the heavy starting current. While the motor is running up to speed, the plungers gradually return to their normal position and are

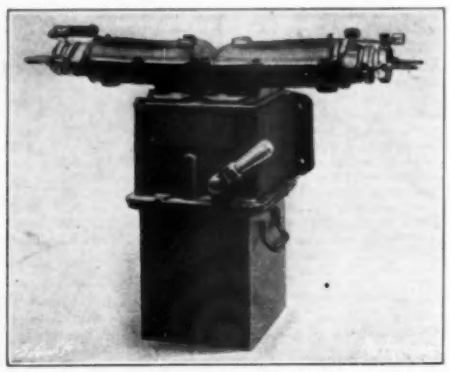


FIG. 35—FLAMEPROOF CIRCUIT BREAKER—REYROLLE

ready for normal operation under running conditions. Provision is made for adequately earthing the metal enclosure of the circuit breaker, and when it is desired to measure the current, a flameproof ammeter is fitted on the top of the enclosure. In the case of the pillar or wall mounting type of breaker, as illustrated, the dividing boxes are arranged so that the complete circuit breaker can be detached from them without altering their position, and the cables need not therefore be unsealed. When a circuit breaker is mounted on a skid, a very compact and portable distribution centre is obtained, with 100 ampère plugs fitted to one side of the circuit breaker to enable trailing cables to be connected up. A circuit breaker can be completely removed from the framework and the dividing box which carries the main cable can be transferred to another circuit breaker without unsealing the cable. Particular attention has been paid

to the design, with a view to making the gear safe. Interlocks make it impossible to remove any plug while the switch is in the "on" position, and the switch cannot be closed when the plug is withdrawn unless the cap that is provided to cover the orifice of the socket is screwed right home. It is therefore impossible for any line contacts to be exposed.

Another interesting exhibit is the Reyrolle ring main isolating switch—Fig. 36—fitted with a switch fuse, so that a connection can easily be teed off a ring main to a small consumer. The isolating switches which are of the oil-immersed quick make-and-break type, are suitable for pressures up to 11,000 volts. Separate switches are provided for each cable of the ring main, and each of these switches can be placed in any of three positions, viz., "on," "off," and "earth," a definite stop being provided,

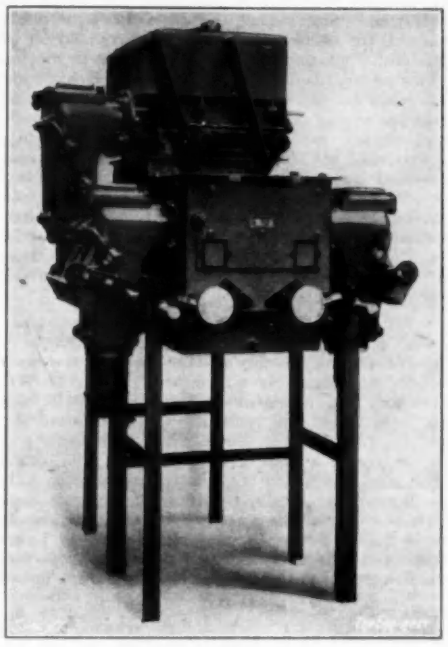


FIG. 36—RING MAIN ISOLATING SWITCH—REYROLLE

so that it is impossible accidentally to move the switch from "on" to "earth." Having been earthed by changing over the switch to the "earth" position, the cable concerned can be handled with safety. At the same time, an interlock is released, which makes it possible to remove a cover over a testing socket, when a plug connector can be inserted and the cable can be tested after the switch has been moved to the "off" position. Interlocks prevent the switch being thrown over to the "on" position when the cover is open, whilst if it happens that when a cable is being tested, it is made alive from the other end, no serious damage can arise, as the testing plugs are provided with a small air gap to discharge any excess pressure. The switch for protecting the consumer's property is oil immersed. The fuse elements are supported from a steel lid, which is made to swing clear of all line parts when replacements are necessary or when it is necessary to replace the fuse. As the whole equipment is proof against flooding, it may be placed in underground manholes, or in other places where flooding is likely to occur.

PARSONS MARINE STEAM TURBINE COMPANY, LTD.

Illustrating the development which has recently taken place in the application of the high-pressure geared turbine for marine propulsion, the Parsons Marine Steam Turbine Company, Ltd., of Wallsend-on-Tyne, is exhibiting a model of the machinery installation for a 5000 S.H.P. single-screw steamer. The steam plant consists of three water-tube boilers of the Babcock and Wilcox type, designed for a working pressure of 500 lb. per square inch with a superheated steam temperature of 700 deg. Fah. The turbines consist of a three-unit arrangement of high-pressure, intermediate-pressure and low-pressure turbines, designed to run at 5000, 3000 and 1700 revolutions per minute respectively, which are coupled to a 90 revolutions per minute propeller shaft through double reduction gearing. The model is complete with all engine-room auxiliary pumps, &c. Another exhibit is a half-size model of a Parsons low-pressure and astern turbine, and various examples of pinions and gears are also on view, along with different specimens of both reaction and end-tightened blading. A model of the steam yacht "Turbinia," the first vessel to be fitted with Parsons turbines, is shown. It will be recalled that the machinery and hull of this ship is now to be seen at the South Kensington Museum, having been presented by the firm to that permanent collection.

THE NORTH-EASTERN MARINE ENGINEERING COMPANY, LTD.

The exhibits on the stand of the North-Eastern Marine Engineering Company, Ltd., of Wallsend-on-Tyne and Sunderland, are representative of the many varied activities of the firm. The largest is a full-sized sectional model of a 560 mm. bore single-acting four-stroke marine oil engine cylinder complete with its valve gear. In Fig. 37 we reproduce a photograph of a model of an eight-cylinder four-stroke single-acting North-Eastern-Werkspoor oil engine fitted with Büchi turbo-charging gear. The arrangement adopted is similar to that recently supplied by the firm for the motor vessel "Raby Castle." A description of this ship and her engines before the turbo-charging equipment was added will be found in THE ENGINEER of April 24th, 1925. The conversion to turbo-charging was made in September last, and after going out to New York on ballast conditions the "Raby Castle" sailed for the Far East *viâ* the Panama Canal at the end of October. By arrangement with her owners the power developed by the converted

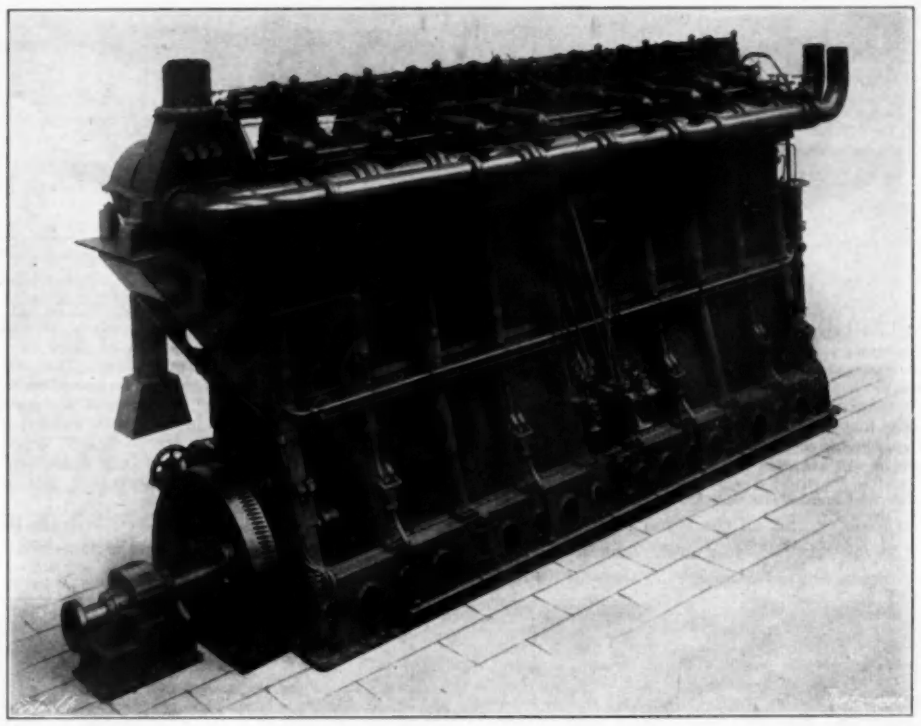


FIG. 37—MODEL OF EXHAUST-TURBO-CHARGED OIL ENGINE—NORTH-EASTERN

engines was limited to an increase of 15 to 20 per cent. over her previous full-power rating of 2186 B.H.P. at 95 revolutions per minute. The displacement of the ship on her eastern voyage was 10,975 tons, as against the average of 10,560 tons for the previous voyages. With the turbo-charging equipment in operation a speed of 11·45 knots was maintained, against 10·95 knots before conversion. The fuel consumption for all purposes worked out at 10·6 tons per day, as against 9·414 tons for the smaller power before conversion. There was no trouble experienced with the exhaust turbo-blower system and the engine worked well under the new conditions. When opened up at the end of last year the turbo-blower was in first-class condition, with only a soot deposit and no carbonising of blades. No renewals were called for, and as a result of the performance of the ship to date the machinery is now being run at an output 30 per cent. in excess of the old full-load rating. Particulars of the later performances will be published in due course; meanwhile considerable interest attaches to the economies in motor ship operation which are made possible by a similar installation to that shown in Fig. 37. Among the models of steam engines we noted one of a typical 3900 I.H.P. triple-expansion unit and also a complete working model of a modern quadruple-expansion engine with cylinders of 23½in., 32½in., 47in. and 68in. bore with a stroke of 48in., designed to develop 2500 I.H.P. Several examples of North-Eastern superheaters are shown, and we understand that the firm is carrying out special work connected with the application of high-temperature superheaters to Scotch marine boilers.

Two interesting devices which are shown concern the removal of oil from feed water and the filtration of feed before delivery to the boilers. In the oil intereeptor use is made of a series of cross baffles which form cells of a square cross section placed with their diagonals in the line of the steam path; the sides of the cells are perforated, but their corners are left intact. The steam passes through the perforations, and any oil is deposited in the angles of the cells and trickles down to a sump arranged at the bottom of the interceptor. Such interceptors are now made in both small and large sizes and are used more particularly on vessels fitted with combined reciprocating and exhaust steam turbine installations.

In Fig. 38 we illustrate a new type of marine feed water filter which is being marketed by the firm. It consists essentially of two main parts: a three-compartment scumming chamber and the filter chamber proper. In passing through the scumming chambers the velocity flow of the feed is reduced and a quiescent state is brought about which enables the greasy particles to rise to the surface in one of the three chambers. These are skimmed off at intervals and the grease collected. From the third chamber the water passes up through a coke basket which is furnished with a machined metal seating to prevent leakage. Around this basket is a series of filter cartridges wrapped with ordinary coarse towelling, and these again are provided with machined coned seatings, which make a tight and easily renewable joint in the bottom plate. A spare coke basket and replace filter cartridges form a part of the equipment.

Some interesting example of Lanz-Perlit castings are shown on the stand. This metal, the demand for which has caused the company to open recently an extended foundry shop, is now widely used for both marine and industrial work. In Fig. 39 we show a group of three fire-bars which have all been in service under similar conditions in the same vessel. The upper view shows a Lanz-Perlit iron fire-bar after sixteen months' continuous service, and it exhibits practically no change either in shape or structure.

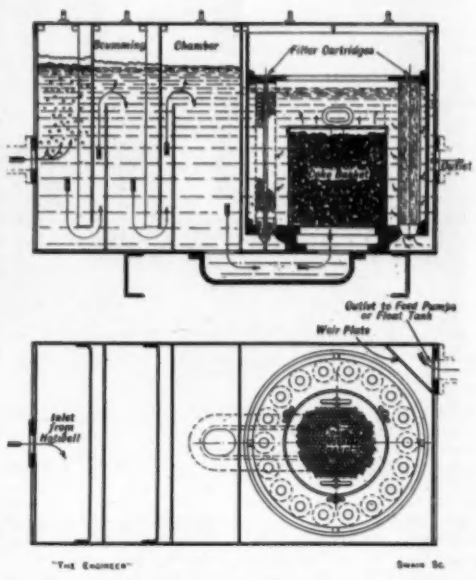


FIG. 38—FEED-WATER FILTER—NORTH-EASTERN

On the other hand, the two lower fire-bars made of ordinary iron have been badly burned away and distorted after only three months of service. Some examples of Perlit iron boiler stay nuts are also shown. They withstood forty-three blows with a 24 lb. hammer, while a similar nut made in ordinary iron failed after three blows with the same hammer. The

Lanz-Perlit metal takes a high polish and is now used for screwing and gear cutting. It is also resistant to heat, and several samples of iron are shown undergoing heat treatment with the object of demonstrating the growth taking place. The specimens are maintained at 1650 deg. Fah., or 900 deg. Cent. in a special furnace, and the superiority of Perlit iron is clearly marked. One exhibit consists of a stepped metal liner, the wall thickness of which varies from ¾in. to 2½in. in four stages. The liner has been machined up and fractured and the Brinell hardness taken every few inches. There is a remarkably consistent fine grain throughout the casting and the hardness only varies very slightly from the normal value of 188 to 191. Castings of Lanz-Perlit iron are now being adopted instead of cast steel for many oil engine parts, and specimens of typical valve levers and casings are shown on the stand.

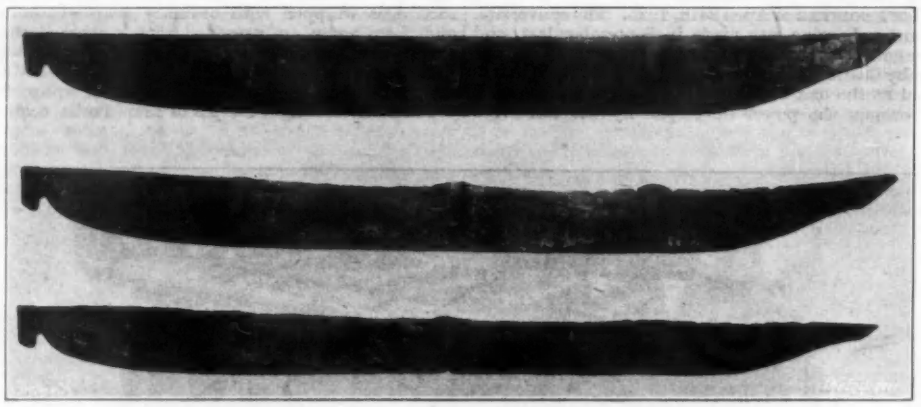


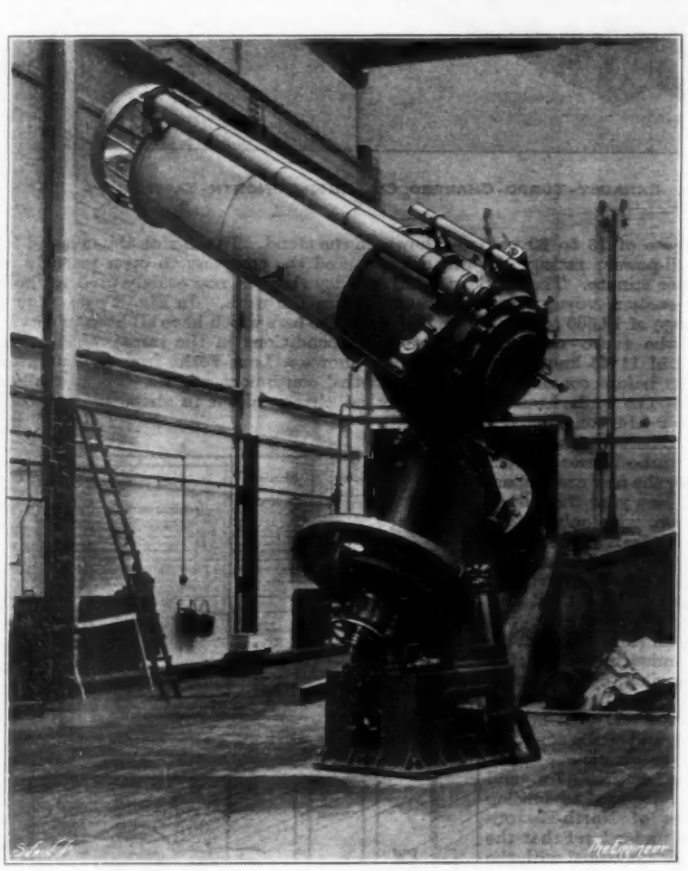
FIG. 39—PERLIT AND ORDINARY CAST IRON FIRE BARS

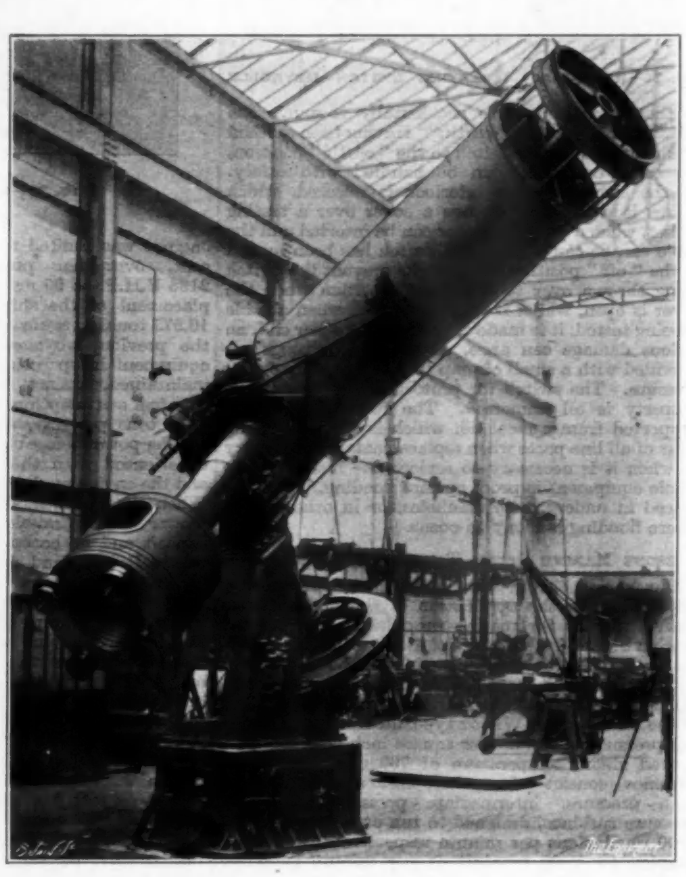
C. A. PARSONS AND CO., LTD.

The main exhibit on the stand of C. A. Parsons, Ltd., of Heaton Works, Newcastle-upon-Tyne, is a 3000 revolutions per minute reaction turbine coupled to a 6250-kW alternator and exciter and designed for a working steam pressure of 165 lb. per square inch absolute. The advance which has taken place in turbine manufacture and design is strikingly illustrated if this large unit be compared with the 4-kW 18,000 revolutions per minute machine shown, which unit is generally similar to those which were supplied by the firm for the lighting of the 1887 Newcastle Exhibition. Another historical model shows an outward radial flow turbine which was built in 1891 and was designed for an output of 100 kW when running at 4800 revolutions per minute and supplied with 140 lb. pressure steam. The shaft adjusting gear employed to reduce the blade clearance to 0·01in., and the steam-jacketed diaphragms for the fixed blades, were new features of the design at that time. The official tests of this machine running as a condensing turbine showed a fuel consumption of 27 lb. of steam per kilowatt-hour, a figure which previously had not been attained. Specimens of early turbine blading and recent blading are to be seen on the stand. An example of the Parsons creep-cut gearing, which is designed to transmit 670 B.H.P. with a speed reduction of 6000 to 600 revolutions per minute, is also shown. The transformer department of the works is represented by a transformer built in 1890, which was in service until a few years ago. Alongside this exhibit is a section of a high-tension and low-tension winding for a present-day 11,000 to 400-volt transformer, and a tapping switch for a 20,000-volt 200-amp. transformer.

Reference was made in our first article to the large searchlights lent by Sir Charles Parsons and the London Electric Firm, Ltd., of South Croydon, which are installed in the towers of the Palace of Engineering and the Palace of Industries. On the stand of Messrs. Parsons there are shown two examples of the firm's searchlight reflectors, one of which is 90 cm., or nearly 3ft., diameter, while the other is 220 cm., or nearly 7ft. 3in., in diameter. This large reflector is mounted in an angle ring, ready for attachment to the back of the projector, and is the largest reflector yet made. It weighs, independent of its mounting, about 420 lb.

An exhibit which attracts much interest, not alone on account of its unusual nature and size, but also because of the fine workmanship it displays, is a 36in. aperture reflecting telescope for the Royal Observatory, Edinburgh, which has been constructed by the Sir Howard Grubb, Parsons and Co. Optical Works, of Walkergate, Newcastle-upon-Tyne. The instrument erected in the makers' works is shown in Figs. 40 and 41, and was designed to a specification drawn up by Professor Sampson, F.R.S., of Edinburgh. It will be used principally, we are informed, for spectrographic observations. The spectrograph for use with the telescope is being constructed by Adam Hilger, Ltd., of London. The optical system is of the Cassegrain form and comprises a large parabolic mirror of 37in. diameter and 6in. thickness with a central 3½in. diameter hole. It has a focal length of 15ft. The Cassegrain mirror is mounted at the upper end of the tube and is of hyperbolic section with a diameter of 10in. It is designed to give an equivalent focal length of 54ft. in combination with the main mirror. As our illustrations show, the telescope is equatorially mounted, the declination axis being arranged on the upper end of the polar axis. All the different motions are electrically operated, and the driving clock, which is normally housed within the base of the instrument, is also on view. This clock is automatically wound by an electric motor of ⅛ horse-power, the rate of revolution of the driving screw being automatically controlled by impulses received every second from one of the observatory clocks. As will be seen from our illustrations, a guiding telescope is fixed parallel to the main tube. It has an aperture of 7in. with a focal length of about 13ft. In addition, there are two finders, one with a 3in. aperture and the other a prism monocular.





FIGS. 40 AND 41—36IN. REFLECTING TELESCOPE—GRUBB, PARSONS

SOUTH DURHAM STEEL AND IRON COMPANY, LTD.

An interesting feature on the stand of the South Durham Steel and Iron Company, Ltd., of West Hartlepool and Stockton-on-Tees, is a 25ft. long, 47in. bore water gas welded single-seam steel pipe which is centrifugally lined with a bitumen composition giving a high internal polish. The outside of the pipe is finished with hessian wrapping. This pipe is generally similar to others of larger diameter which have been manufactured by the company for the Lochaber power scheme and for other hydro-electric power installations. A 24in. bore pipe bend with flanges bituminous lined is also shown as well as examples of different pipe joints and seams. The company also produces black and galvanised plates and roofing sheets, and specimens of these products are to be seen on the stand. There is also a large model illustrating the new design of "Talbot" open-hearth steel furnace, which embodies some new features.

THE bunkering facilities at Cape Town docks are such that a steamer recently took on board 4000 tons of coal between its arrival in the evening and departure next morning.

Railway and Road Matters.

THE vacancy on the Indian Railway Board, created by the retirement of Mr. P. C. Sheridan, has been filled by Mr. H. A. M. Hannay, the chief operating superintendent of the East Indian Railway.

CONTROL of vehicular traffic at the intersections of busy streets by means of colour light signals is now, according to the *Manchester Guardian*, in use in twenty-one localities in this country.

FOLLOWING the course taken by the French railways, the goods rolling stock on the Belgian railways is to be equipped with the Westinghouse continuous brake. There are 70,000 vehicles and the work will take five years to complete.

A CORRESPONDENT, writing to *The Times*, calls attention to the introduction in India of through communications, without change, between Mangalore on the South Indian Railway and Peshawar Cantonment, a distance of 2497 miles.

AN explanation offered by the London, Midland and Scottish Railway for so large a proportion of its passenger stock still remaining gas-lighted is that so much of it is used only for holiday and excursion traffic. Travellers to and from the North just now by that line can appreciate that point by the number of carriages now stored in sidings which apparently were used for the Whitsuntide traffic. These include coaches painted in the former Lancashire and Yorkshire colours, and many six-wheeled vehicles.

THE Canberra correspondent of *The Times* cables that the conference of the Premiers of all the States of Australia has agreed to the creation of a Federal Transport Council, consisting of a Minister from each State, with a Minister of the Commonwealth Government as chairman, to meet immediately and prepare a scheme of railway finance separate from the general finances of the States, to formulate a programme for the future conduct of the railways and other means of transport, and to investigate the unification of gauges.

THE expert, Mr. A. R. Fearnley, of Sheffield, called in by the Tramways Committee of the Exeter City Council to advise as to problems of extension and the future of the tramway undertaking generally, recommends that no further money be spent upon the system, except such as is sufficient to keep it in immediate operation, and that instead of carrying out a suggested extension, double-decker, top-covered motor omnibuses of the latest low-loading type be immediately obtained. Mr. Fearnley advises the Committee against the adoption of the trolley bus system.

THE June issue of the *Great Western Railway Magazine* states that applications have occasionally been made for the purchase of engine name-plates recovered from the Great Western Railway engines as they are taken out of service, and the applications are mainly founded on sentimental grounds. There is a fair number of these engine name-plates on hand at Swindon, and an opportunity is now given for any interested member of the staff or general public to obtain one or more of them. Full descriptive particulars can be obtained on application to Mr. A. C. Cookson, Stores Superintendent, Swindon.

MANY of the regular travellers by the former London and North-Western steamers in pre-war and post-war days will regret to hear of the death of Captain Pinchin, R.N.R., who was the Commodore of the fleet, and in charge of the "Scotia." During the earlier part of the war the "Scotia" was on patrol duty in the Bristol Channel, but returned to railway service in May, 1917. She, however, went back to war services and acted as an escort ship to the Dardanelles. It was whilst in the latter service that, under fire, the "Scotia" rescued Commander Holbrooke after his exploit, and towed his submarine for 200 miles.

OF the eight railway directors who sat in the House of Commons in the late Parliament, three—Sir Evelyn Cecil, Major David Davies and Sir Murrow J. Wilson—did not seek re-election. Four—Major W. H. Carver, Sir George Courthope, Mr. E. B. Fielden and Sir Robert Horne—have been re-elected. The eighth—Mr. Cyril Lloyd—was defeated at Dudley by Mr. Oliver Baldwin, a Socialist, the son of the Prime Minister. The railway unions have had remarkable success with their candidates. The National Union put up eleven candidates officially, of whom eight were elected, and the Railway Clerks' Association had eight, of whom seven, including the President and general secretary, were elected. The Associated Society nominated only the general secretary, and he was elected. Eight railwaymen were in the late Parliament, and they have again been elected, and are now joined by twelve others, making a total of twenty. Four of the unofficial successful candidates were the nomination of the local labour parties.

A RECENT decision of the United States Supreme Court concerns what is known in America as "the greatest case in history." It is not without some interest to railway officials and traders here, but some little explanation is necessary before the facts are related. In 1913 the Interstate Commerce Commission secured powers to make a valuation of all the railways. The declared purpose for that legislation was to see that the rates and charges were commensurate with the cost of property. When, after Federal control during the war, the Transportation Act, 1920, was passed, the Interstate Commerce Act was provided with additional clauses, known as Sec. 15 (*a*), which, in relation to railway charges, speaks of their bringing in "a fair return upon the aggregate value of the railway property." As mentioned in this column on December 30th, 1927, the companies maintain that the value referred to is the value of to-day. The Commission, on the other hand, argues that it is the value at the time of the Valuations Act. As stated in our issue of the date named above, the Federal Court which heard the case originally supported the Commission, so the railway company concerned—the St. Louis and O'Fallon, owning a line only nine miles long in the Illinois coalfields—appealed, and the case was regarded as a test. Now, on May 20th, the United States Supreme Court, by five votes to three, reversed the decision of the Federal Court. The charges of other public utilities concerns are also governed by such valuations and in that direction, too, the decision is important.

Notes and Memoranda.

FOR the purpose of conveying helium gas from its plant at Amarillo, Texas, to the Langley flying ground, Virginia, the American Government uses a tank wagon holding 200,000 cubic feet of gas at a pressure of 2000 lb. per square inch.

IT is claimed that the canals of Canada set up new records of traffic last year. The St. Lawrence canals showed an increase of 498,590 tons, as compared with 1927, the total being 7,321,348 tons. The canals at the Soo increased by 536,586 tons; that at Chambly was less by 24,466 tons; while the Welland Canal increased by 192,158 tons.

ONE of the smallest railways in the world, the Kent Northern, which is to be bought by the Canadian National Railways, has, says *Canada*, one box car, one flat car, one first-class car, one combination car, two snow ploughs, and three switching locomotives. It has a single track 28 miles long, running from Kent Junction to Richibucto. It carried about 6000 tons of freight last year, and several passengers.

COMPARING explosives containing the regular nitroglycerin, and those containing ethylene glycol dinitrate, the American Bureau of Mines comes to the following conclusions:—(1) Propulsive strength is unaffected by age, and is the same for both types of explosive; (2) sensitiveness to sympathetic detonation is slightly greater in the case of the dynamites containing ethylene glycol dinitrate; (3) determinations of rate of detonation indicate that, with some exceptions, the explosives containing E.G.D. show—(*a*) slightly higher rates of detonation when unconfined, (*b*) slightly greater increase of rate when primed with 40 per cent. straight nitroglycerin dynamite, and (*c*) slightly better ageing properties.

THE American Society of Mechanical Engineers has proposed a new unit of measure to indicate industrial efficiency—the kilo-man-hour, the labour of one man working 1000 hours. In other words, the Society recommends measuring output per man-hour instead of output per man, as is usually the case. It is reported that when all other factors in any business have been divided by the number of kilo-man-hours worked, some surprising figures have been obtained. Thus it was found that in making grey iron castings, the variation between companies was in the ratio of 16 to 1. In many instances, small concerns showed a higher physical output per kilo-man-hour than large companies in the same business.

AT a recent meeting of the Institution of Gas Engineers, the President, Mr. John Terrace, M. Inst. C.E., stated that a committee had been appointed to investigate the use of gas for therapeutical purposes. It was too soon, however, to expect results from the experiments being carried out. Nevertheless, he could mention as one practical recent result of research that a new radiant for gas fires, which possessed considerable health-giving powers, had lately been put on the market. This radiant provided a more penetrating, and consequently more comfortable heat than the older radiant, because the beneficial infra-red rays pentrated to the blood in a way hitherto not possible. This is a matter of some interest at present. It has recently been pointed out by Dr. Saleeby, chairman of the Sunlight League, and others, that "sun-heat"—the infra-red rays—is as important to health as "sunlight"—the ultra-violet rays.

THERE are a number of differences, according to Mr. L. C. Ilsley, of the American Bureau of Mines, between the electrical installations in Great Britain and the United States. For instance, in British coal mines there are no trolley locomotives, whereas statistics compiled for 1924 give 11,986 in the United States. Every piece of apparatus and practically every conductor in British mines is earthed by carrying a ground conductor to a ground plate on the surface; practically no earthing is resorted to in American mines except to connect the frames of stationary motors to a pipe or rail return within the mine. Alternating current is not used extensively in American mines, but in British mines this prevails, and direct-current circuits are being replaced by alternating-current circuits in a number of mines. The natural conditions in British mines as to grades, faults, thinness of seams, extreme depth of shafts, and the difficulty of properly supporting the overburden render the installation of electrical equipment much more difficult than in American mines. In regard to electrical safety, it can be said without danger of contradiction that the regulations governing the installation, inspection and maintenance of electrical equipment are better in Great Britain than in America. In regard to the practice of using strictly safe equipment in gassy sections of mines, there is much yet to be done in both countries.

CALCULATIONS which have been made by Mr. C. G. Maier, of the American Bureau of Mines, show in a quantitative way that the presence of less than 0·1 mm. carbon monoxide pressure in an atmosphere of otherwise pure carbon dioxide will act reducingly towards cuprous oxide at all temperatures where both the copper and oxide are solid; *i.e.*, below the eutectic (1064 deg. Cent.). The equilibrium changes with the temperature in such a manner that below 900 deg. decreasing quantities of carbon monoxide suffice to reduce cuprous oxide. At higher temperatures, near and above the melting point of copper, less accurate but still fairly reliable figures were obtained showing that a partial pressure of 7·6 mm. CO in otherwise pure CO_2 should reduce the dissolved cuprous oxide content to ·008 per cent. These concentrations define the limits which must obtain technically in the bright annealing of copper when carbon monoxide is the reducer, and furthermore suggest the possibility of the use of a CO_2 atmosphere containing small amounts of CO for the deoxidation of copper both in the solid and liquid state. If the oxide content of ordinary grade copper wire is eliminated, it is well known that an increase of 2 to 5 per cent. in electrical conductivity may be obtained. Present wire drawing practice often involves the use of steam for protection during annealing, and it is not impossible that substitution of carbon dioxide containing small amounts of carbon monoxide might result in considerable saving on the basis of pounds of copper per unit of conductivity, because it would permit some decrease in the original oxide content of the metal to be obtained.

Miscellanea.

A NEW galvanising factory is to be put up at Hereford by Baldwin, Ltd.

SIX geological survey parties have set out to explore the Gaspe Peninsula, Quebec, with the object of discovering mineral and oil deposits.

A CONTRACT amounting to nearly five million pounds has been awarded to a British firm by the Roumanian Government for road building work.

A PLOT of land, of 30 acres, in New Brighton, near Port Elizabeth, South Africa, has been purchased by Lysaghts Ltd., for the purposes of establishing a nail-making factory.

THE two Erewash Valley blast-furnaces at Ilkeston, Notts., which have been out of service for some years, are to be pulled down, as they are considered to be obsolete.

ACCORDING to reports from Copenhagen some rich deposits of precious metals have been discovered near Reykjavik, Iceland. Gold ore containing 30 grammes of metal per ton and silver up to 540 grammes per ton, are said to have been found.

THE new general manager of the Birmingham Section of the British Industries Fair, in succession to the late Mr. C. Stanley, is Mr. C. Elliott, who has had considerable experience on the Great Central Railway, in chemical works in North Wales, and in private practice as a consulting engineer.

AN address by Mr. Norman A. Yarrow on commercial aviation was one of the features of the annual meeting of the Victoria and Vancouver Island Branch of the Canadian Manufacturers' Association here. Mr. James Parfitt was elected chairman of the branch, and Mr. W. A. Jameson vice-president, while Captain T. J. Goodlake was re-elected secretary.

THE 50 metre wide lock at Ymuiden, the port at the entrance to the North Sea Canal which connects Amsterdam with the sea, is now rapidly nearing completion, and is expected to be open to maritime traffic in September next. The new lock at Ymuiden has twice the capacity of the Gatun Lock on the Panama Canal, and, when completed, will be the largest lock in the world.

RAPID progress is being made, according to the *Ironmonger*, in the erection of a factory and plant for the Sheffield Iron Corporation, of Adderbury, Banbury, and experiments with a new process for iron ore treatment will be tried on a commercial scale. If successful it is anticipated that English ores will offer greater economies for iron production than the foreign ores now imported.

THE Institution of Gas Engineers has just been granted a Royal Charter. The Institution attained its Jubilee in 1913. It was first formed as an unincorporated association under the name of the British Association of Gas Managers, having for its objects, "the encouragement and advancement of all matters connected with gas engineering, manufacturing and finance and the exchange of information and ideas among its members." In 1902 the Institution in its present form came into being.

THE Secretary for Mines announces that the following additional members have been appointed to the committee set up to investigate, under the general direction of the Safety in Mines Research Board, possible methods of reducing the number of accidents from falls of ground in coal mines:—Mr. T. Banks, Mr. F. L. Booth, Mr. T. Cape, Mr. R. W. Glass, Mr. W. Golightly, J.P., and Mr. W. P. Richardson. These additional members are appointed for the purpose of the investigation which is being undertaken into the methods adopted in the coalfields of Cumberland, Durham and Northumberland.

AMONG the schemes at present in contemplation for the improvement of the shipping facilities at Glasgow Harbour is a proposal to instal belt conveyors for the loading of coal. The London, Midland and Scottish Railway Company is at present in negotiation with the Clyde Navigation Trust regarding the details of the scheme. The company's intention is to provide two belt conveyors at the General Terminus Quay on the south side of the river. These would take the place of the railway company's five steam cranes, and the plant would be used for the loading of cargo coal as well as for the shipping of bunkers.

WRITING to *Nature* with regard to the Presidential address to the Iron and Steel Institute by Professor Louis, a correspondent says that the early history of iron had been carried much further back by discoveries in South Palestine, published in *Gerar* last year. Furnaces were found dated to 1100 and 1175 B.C.; the earlier was 67in. by 36in. At the side of the furnace lay great hoes, 11in. by 5in., plough socks, and a pick of 6 lb. weight, showing that iron was as commonly used then as now. The earliest example was a knife of 1350 B.C., and this accords with the date of the polished steel dagger of Tutankhamen. This year another steel dagger, with cast bronze handle, has been found, of about 1300 B.C.; as it was snapped in two anciently without any bending, it could not be soft iron.

CANADIAN firms are likely to be awarded most of the contracts for the construction of the new 7,500,000 dollars power plant of the British Columbia Electric Railway Company on the Stave River, near Ruskin, B.C. Contracts for the first unit to develop 42,500 horse-power at a total outlay of 680,000 dollars have all been let to Canadian firms. Foundations will be laid for four other units of similar capacity. The Dominion Engineering Works, Ltd., will construct the hydraulic turbine at its Montreal plant. The Canadian Westinghouse Company at Hamilton will build the generator, and the Canadian General Electric Company at Toronto will construct four step-up transformers. As announced some time ago a contract for the construction of the dam being erected on Stave River in connection with the development was awarded to Stuart Cameron and Co., Ltd., and Armstrong, Morrison and Co., Ltd., Vancouver. The contract price was 882,987 dollars. In addition, it was estimated that an expenditure of some 300,000 dollars would be entailed for the cement to be supplied by the B. C. Electric Railway Company.

10,000-kW THREE-CYLINDER STEAM TURBINE

SKODA WORKS LTD., PRAGUE, ENGINEERS

(*For description see page* 632)

FIG. 1—RIGHT-HAND SIDE OF TURBINE

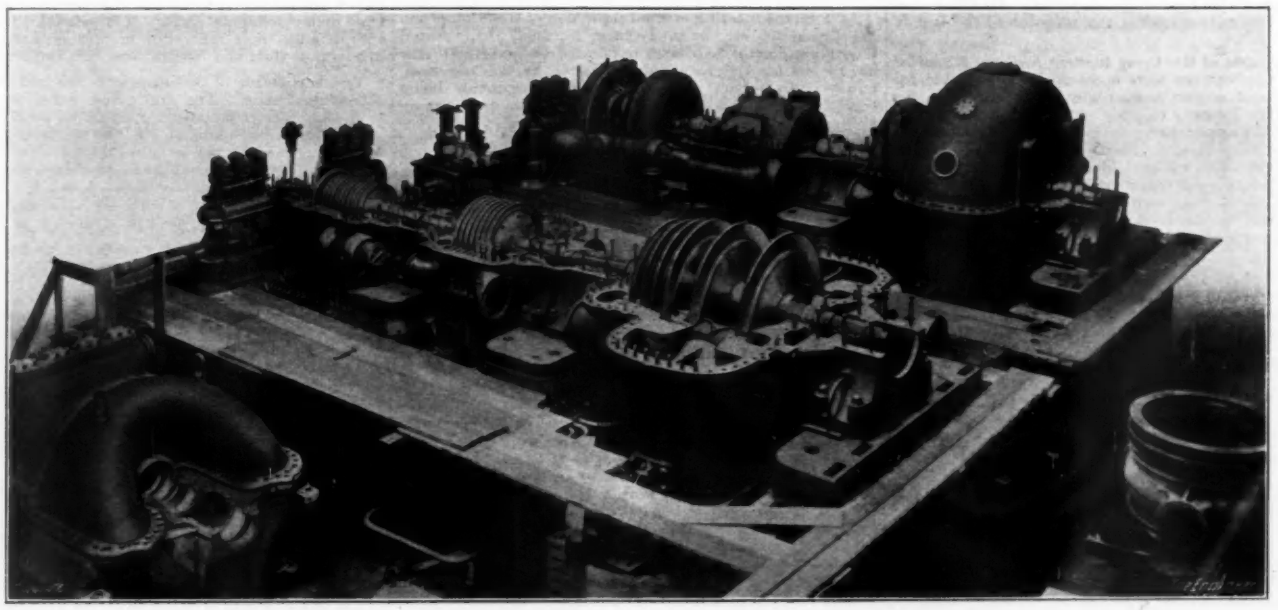


FIG. 2—PAIR OF TURBINES UNDER ERECTION

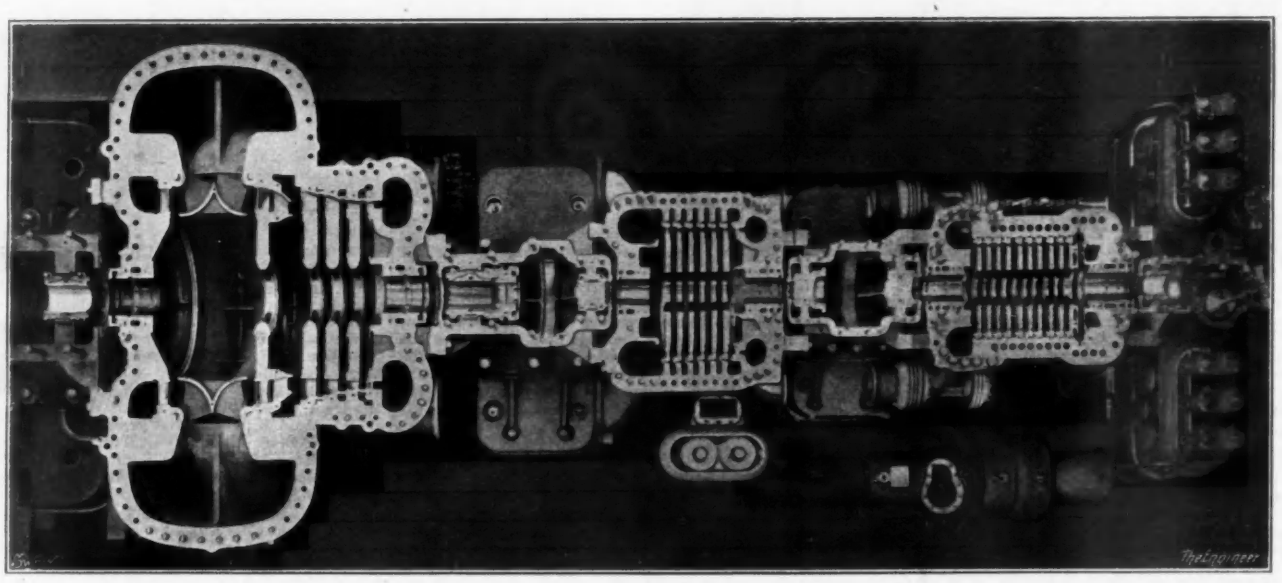


FIG. 3—PLAN VIEW WITH TOP CASINGS REMOVED

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THE ENGINEER.

JUNE 7, 1929.

The Purification of Flue Gases.

ONE of the persistent problems of a civilised community is to dispose, inoffensively, of waste products. The denser and more highly industrialised the population, the greater becomes the difficulty, not only on account of the increased magnitude of the task and the ever more limited space available for Nature to effect purification in her own way, but also by reason of the greater insistence that neither earth, water, or air shall be polluted to the harm or inconvenience of man. The technique of the disposal of sewage and of various kinds of trade wastes has been intensively studied, because any offences are patent to the world. It is not so with chimney gases, which are invisible and in dilution practically odourless. That these waste products of combustion are, or may be a nuisance, is only now coming to be generally recognised, and engineers are faced with the problem of rendering them as inoffensive as the air into which they are discharged. This ideal may seem a high one, but we see no reason why it should not eventually be attained. There is fortunately not the slightest objection to the matter which a chimney must necessarily emit; 80 per cent. or so of it is pure nitrogen, of which fresh air contains almost exactly the same proportion. If we add to this about 8 per cent. of pure oxygen and 12 per cent. of pure carbonic acid gas, we have roughly the composition of the whole of the necessary flue gases, leaving out of account the water vapour accompanying them. Even the percentage of carbonic acid gas need not alarm the most timorous, seeing that they themselves are emitting over 4 per cent. of this gas every time they breathe. Such nuisance as a chimney may create does not therefore lie at the door of what may be called the pure flue gases. It consists entirely in the discharge of comparatively very small quantities of extraneous matter in the form of soot, tarry vapours, grit, and sulphurous fumes. It is these that have to be prevented, surely and continuously, from escaping in order to render chimneys free from reproach.

It is common knowledge how much has been done towards the suppression of the smoke evil by improvement of furnace conditions, and substantial progress has been made with regard to the retention of grit. Few engineers, nevertheless, would be willing to guarantee the absolute smokelessness of their chimneys during the next twenty-four hours, in view of the necessity of soot-blowing and the inevitable variations in furnace operation. Fewer still would like to guarantee the absolute gritlessness of their waste gases, especially with forced draught, inferior fuel, and heavy loads. As to sulphurous fumes, none could guarantee anything, as there is at present no recognised way of dealing with them. Supposing that, before long, some method is found of combating the sulphur nuisance —say, by giving the gases some cheap material to attack, instead of setting them free to damage buildings and vegetation—we should even then be left with a considerable degree of uncertainty with regard to smoke and grit. The only complete solution to the problem would seem to consist in discharging no gases into the air until they had undergone some thorough system of purification, which would eliminate not only sulphur, but soot, tar, and grit as well, if any were present. We should then have the perfect chimney, from which nothing could emerge but clean, pure, and harmless gases. If this end is only to be attained by washing the whole of the products of combustion, then this eventuality has to be faced. And when faced, it does not appear to be by any means impossible. The volume to be dealt with is large, but engineers have grown accustomed to handling large volumes. The products of combustion from a modern power station boiler have now to pass through an economiser, an air heater, an induced draught fan, and a dust catcher, besides the necessary ducts, and the whole of this apparatus, in turn, has to accommodate their volume at a reasonable speed. To pass them through a washer, in addition, would add little, proportionally, in bulk or in complication to the existing plant. Indeed, it has not been thought extraordinary for a large power station in this country to put down wet air filters of an aggregate capacity of 350,000 cubic feet per minute under the alternators in the turbine-room. Since in the station referred to the total volume of the flue gases is considerably less than that of the air which has to be cleaned and cooled for the alternators, there should be no insuperable difficulty in finding room for a gas-cleaning plant in or near the boiler-room. The question of providing the necessary amount of wash water, and particularly of disposing of the dirty effluent, might well be more serious. The obvious reply to the latter point is that it is fairer for a power station to have to deal with the dirt in the flue gases itself than to pour it out of the chimney on to the heads of the neighbours. The loss of the natural draught on account of the lower temperature of washed gases can hardly be urged as an objection against washing. Very few stations rely on anything but mechanical draught nowadays. Moreover, the clean cool gases could be discharged by smaller and shorter chimneys than are now necessary. In considering the question of the purification of flue gases, an alternative to washing, which would mitigate or abolish the sulphur trouble should not be lost sight of. Every station engineer knows the corrosion of economisers and air heaters which occurs when any part of them in contact with the flue gases is not kept hot enough to avoid the condensation of the moisture in the gases. In such a case the layer of gas next to the metal becomes chilled and deposits its moisture. This absorbs the sulphurous fumes, becoming converted into a weak solution of sulphuric acid, and the trouble begins. Were the whole of the gases to be deliberately cooled to a temperature below the dew point, it would seem probable that all the sulphur could be eliminated as sulphuric acid, and afterwards be converted into an inert and harmless sulphate by contact with limestone. The cooling of the gases would, of course, have to be done in some apparatus which would not be destroyed by the sulphuric acid formed, but the progress in the manufacture of non-corrosible metal has been so great of recent years that this should present no serious difficulty. Taking the fuel and gas analyses of a recent test, it would appear that for those particular conditions the dew point of the gases would be reached at a temperature of 97·5 deg. Fah., while a further diminution of 4 deg. would precipitate enough water to take care of the whole of the sulphur originally in the fuel. It should be quite possible to get such temperatures, even in a cooling tower station, especially as the extra heat to be abstracted from the gases will only be about one-tenth of that which has to be taken away by the circulating water in any case. Whether

it would pay to attempt the recovery of any part of the extra heat which could be obtained by cooling the gases below the dew point is doubtful, but there is always the possibility of doing this. With total chimney losses already reduced to 10 per cent. or less of the gross calorific value of the fuel, the margin for further reduction is not very great. The heat now carried away by the waste gases constitutes, nevertheless, by far the greatest single item of loss in a boiler plant heat balance, and the only item by whose reduction the boiler efficiency could be measurably increased. If, then, by doing what we strive to avoid now, namely, cooling the gases sufficiently to bring about the deposition of moisture, we could not only get over the external sulphur trouble, but at the same time fractionally increase boiler efficiencies, the plan would seem worth trying.

The important thing at the moment, however, is to get rid of the sulphur, and since we know that this comes down as a virulent acid when the gases are inadvertently chilled, advantage might be taken of this knowledge to bring it down deliberately in apparatus to which it could do no harm. The scheme, if successful, would remove the most serious of the reproaches against well-operated chimneys. But what is needed is some method of eliminating with certainty every possible cause of complaint, whether it be the emission of soot, tar, grit, or sulphur. The problem is one for which piecemeal solutions are likely to have to give way to some general treatment of the gases, whereby noxious additions of any kind will be prevented from polluting the atmosphere. When we have a study of chimney effluents at all comparable with the attention paid to sewage farm effluents, it will not be long before any chimney sending forth anything but the three necessary, pure, and harmless products of combustion will be looked upon as committing an offence against the community.

The Power of Machine Tools.

THE load factor is a very useful term invented by power station economists to show the relationship between the average load and the maximum load during a given period, but it is capable of many other applications. It is frequently, but improperly, extended to mean the ratio between the maximum capacity of a power-house, a factory, an office, a machine tool, a locomotive, or what you please, and the actual capacity employed. In America the term plant factor is given to the latter relationship. It is often very difficult to settle the length of the period which should be taken into account. For example, the engines of a ship crossing the Atlantic at a steady speed all the way have a plant factor of approximately 100 per cent. But, taken over the year, the plant factor is pulled down by the days and weeks that the ship spends in port. Again, a factory working steadily eight hours a day may have a plant factor of 100 per cent. if the eight-hour period is taken as the basis, or a plant factor of only 33⅓ per cent. if the factory is capable of running continuously for twenty-four hours on end. There is sometimes a temptation to regard any plant factor lower than the highest as indicative of wasted time. The load factor is then a safer guide, for when it is employed the maximum load is usually determined by integrating the load during successive equal intervals of time taken during the working period and recording the highest. Thus it shows us how nearly we are approaching the best that has been done over a reasonably long period, not the very highest that has ever been attained or that is capable of attainment. The bowler who did the hat trick would resent it were he told that he was off form if he failed to take nine wickets for every nine balls!

When estimating the output of factories or machines it is necessary to bear in mind the distinction to which we have alluded. If a machine tool is too big for the average job which it has to perform it may have a very poor plant factor; but its load factor may be reasonably good; indeed it may easily be made too good by establishing the maximum load at too low a level. In every works there are machine tools that have to operate much of their time far below capacity, to say nothing of prolonged periods when they must perforce stand idle for lack of work to be done. Neglecting the latter, how is the proper amount of power which ought to be provided for any given tool to be settled? In other words, if it is an independent machine, what size of motor shall be fitted to it? If a high plant factor is desired the motor must be kept as small as possible and the machine must be worked continuously at full capacity. That is quite possible with simple single-purpose machines in which both the load factor and the plant factor may approach unity. But for general purpose tools there is no possibility of attaining that high level. For the roughing cut the maximum power of the motor may be called for, whilst the finishing cut requires but a fraction of it. Here it is that the load factor is a safer guide than the plant factor. But it will not help us to estimate the size of motor that must be fitted, and that is the rub. A recent American author has come to the conclusion that a great many machine tools are over-powered. He found that when the horse-power was between one and ten the size of the motor was prescribed by the maker in 37 per cent. of the purchases and in 30 per cent. when the power was between ten and fifteen. It appears that in the majority of these cases the makers specify a motor large enough "to take care of the maximum load capacity of the tool, without reference to the type of work for which the tool is to be used." Others measure or estimate the horse-power required for the jobs to be done on the machine and fit a motor of the necessary size. The position of the former seems to be the more logical of the two. If only a 10 horse-power motor is fitted to a lathe strong enough to handle fifteen, then the lathe is unnecessarily large in some respects. Moreover, the user can never get the full capacity out of it because it is permanently under-powered. Take the other case in which the motor is too powerful for the work which the machine has to perform, then clearly the whole machine is too strong and the mistake is not in the motor, but in the machine itself. The most probable position is that the user wishes to have a reserve of capacity and orders a machine on the large size. If he cuts the motor down he curtails the capacity by lack of power, but if, as some makers advise, he puts in a motor up to the full capacity of the machine his reserve is always available at a moment's notice. Against this advantage he must set the increased depreciation charges on the larger motor, but he need allow very little for loss of efficiency unless the motor is grossly oversize. He may indeed have a relatively low plant factor, but the load factor may be just as good with the large as with the small motor.

The estimation of the power which should be provided for machine tools is a standing problem to which no complete solution has ever been found, save in the case of special purpose machines engaged all their useful lives upon one class of work. The simplest plan, unquestionably, is to make provision for as much power as the machine can ever consume usefully and, on the whole, it seems to us to be the best. If a choice has to be made between a machine too big for its normal power consumption and a motor too big for the normal demand that will be made on it, we are inclined to believe that of the two the latter is the better. In other words, it is quite as important that the motor should suit the capacity of the machine as that it should suit the operations that have to be performed. But, judging from the remarks of our American author, who is probably in the "automotive" industry, there are other points of view, and we should welcome an expression of opinion on the subject from works managers.

Incorporated Municipal Electrical Association.

No. I.

ALTHOUGH the President of the Incorporated Municipal Electrical Association this year is Mr. A. Nichols Moore, engineer and manager of the Newport, Mon., electricity undertaking, the Council was once more compelled to go to some other town than that of the President in which to hold the Convention, by reason of the lack of hotel accommodation for the large numbers which now attend, an average figure for several years now being between 700 and 800. As a matter of fact, the number exceeds 1000 this year. Thus it is that the I.M.E.A. Convention for 1929 has been held in Torquay during this week, and will conclude to-day—Friday. A glance at the work carried out by the Association, as shown by the Council's reports for the last few years, indicates quite clearly the enormous field waiting to be developed in regard to distribution as distinct from generation of electricity. Indeed, the bulk of the members of the I.M.E.A. will eventually not generate electricity at all, owing to the operation of the Government scheme, and those who expressed fears a few years ago that the Association was reaching the limit of its sphere of usefulness quite misjudged the situation.

The Convention opened officially on Tuesday, June 4th, and met daily until Friday, June 7th, when, as usual, the annual general meeting was held, the new President being Mr. J. K. Brydges, of Eastbourne. On the opening day there was the usual civic welcome, followed by the presidential address by Mr. A. Nichols Moore.

The President devoted a large part of his address to a general review of the work of the Association during the past year, and presented a *résumé* of matters of outstanding interest in the electricity supply industry. The feature of the address, however, was a suggestion that distribution of electricity will have to be undertaken in a more or less national basis if the full effects of the scheme of the Electricity Act of 1926 are to be felt. It is now becoming a definite conviction, said the President, that however much the Act may assist in the securing of economic generation, it cannot alone solve the problem of the provision of an ample and economic supply throughout the country. Is it within the realm of practical politics to evolve some scheme as truly national in character and as co-ordinated in practice for distribution as is represented by the Government scheme for generation? In other words, is it possible for all the existing interests, *qua* distribution, to be merged into a comprehensive scheme working upon a unified basis of policy, administration and technical direction, and under a central governing control, whose aim would be the rationalisation of the electricity supply industry? Rationalisation does not mean the creation of a monopoly or the maintenance of prices, nor the extinction of public and private enterprise as such, but rather the setting up of a community of interests to regulate and develop the electricity supply industry to the fullest extent possible and under the most efficient and economical conditions. Whilst fully realising the inherent difficulties, the opinion is expressed that such a scheme is within the bounds of practical politics. As emphasising this, reference is made to what is being done in Germany in this direction by the central controlling body, the Berliner Städtische Elektrizitätswerke Aktiengesellschaft, known popularly as the Bewag. The status of this body is in effect that of a holding company, but all the shares are held by the municipality of Berlin. Its administration is in the hands of a board of management, which is assisted by a supervisory board consisting of municipal representatives, technical experts, and representatives. The business of the Bewag is the development of electricity supplies, including distribution, and the provision of electrical apparatus for industrial and domestic purposes. There are also two other operating companies which work under agreement with the Bewag, and administer the business of electricity supply within their own areas. The President said he was assured that the scheme is proving itself to be a practical solution of the problem of a real development of electricity supplies upon a co-ordinated basis. He added that one can perhaps visualise the possibilities of holding companies formed for the further development of electricity supplies, and especially distribution, financed and controlled by municipalities and possibly private companies interested in distribution in a particular area, and administered by a permanently appointed board of directors, who are experts on the technical and commercial sides of the electricity supply industry, and who, together with their supervisory staffs, would in effect be the employees of the holding companies, and not of any individual local authority or private company. Such a plan, it is contended, would facilitate the development of a common continuous policy within a large area, and the control and administration, if not entirely separated from political influences, would at least be permanent and capable of definite and independent action.

With such bodies it would obviously be more simple for the Central Electricity Board or some other authority to deal, and the control which these bodies would have over distribution within the extended areas, and jointly over all areas, would only be limited by their capacity to deal with the requirements from a national as well as from a local point of view. Such a system, it is suggested, would wipe out existing and avoid future overlapping, it must obviously result in economies in both administration and operation, and it would enable a united and more powerful front to be presented to any opposition or to any attempt at squeezing the industry.

Following the presidential address, a paper was presented by Alderman Walker, of Manchester, on "Whitleyism in the Electricity Supply Industry from a Management Point of View." Alderman Walker who has associated himself very definitely with the Whitley Council movement in the electricity supply industry, had prepared a paper for the 1926 Convention on the subject, but it was not presented because of the 1926 general strike. In the present paper he relates the history of events up to 1926 and records the happenings since then which led to an agreement in December, 1927, since extended to December 21st, 1929, between the employers and the trade unions. Whilst recording that since the Industrial Council was established for the industry there has been no serious dispute and no stoppage—it is suggested that the large percentage of employees in electricity supply works who remained at their posts during the strike of 1926 was due to the good relations brought about by the Whitley Council. Alderman Walker, at the same time, points to certain

dangers. He deprecates the tendency on the part of certain trade unions always to be endeavouring to obtain better conditions in the electricity supply industry at a time when those conditions are superior to those in almost any other industry, and points to the almost certainty that other industries which are large customers of the electricity supply industry will resent unduly favourable conditions being granted to electricity supply employees without regard to the conditions in which men in other industries are working. At the same time, he equally criticises municipal supply authorities who fail to honour in the last degree any agreements come to between the employers and workpeople. Alderman Walker, however, stands as a staunch champion of the Whitley Council in the electricity supply industry and advocates steps being taken by which decisions come to by unanimous votes of such Councils shall be given compulsory effect on the basis of the Industrial Councils Bill, which was introduced in 1924, and passed a second reading in the House of Commons by a majority of 220, although, owing to political conditions, it has not yet been reintroduced. Under this Bill an Industrial Council by adopting the conditions laid down in the Bill can make its decisions compulsory upon all members of its Council.

The discussion on Alderman Walker's paper was neither very long nor very profound, consisting for the most part of speeches by Councillor members of the Association who exhibited greater assurance than ever by reason of the recent change in the political situation, and urged that employees should share in the management of the industry. At the same time comments were made by the same class of speaker, urging the need for good relations between employers and employed, not by revolutionary methods, but by the exercise of common sense all round.

On Wednesday, June 5th, a paper was read in the morning by Mr. James H. Rothwell, hon. solicitor to the I.M.E.A., in which he commented upon some recent High Court decisions and other current legal problems in connection with the generation and supply of electricity. Naturally, the important case in which the Manchester Corporation has been sued by reason of damage to crops through the emission of sulphur fumes and sulphurous compounds from its Barton power station received mention. At the moment, the position is that the judge in the Court of First Instance and one Appeal judge are against the applicants in the case, whilst two Appeal judges are against the Corporation, and it is the intention to take the case to the House of Lords. In the meantime, the Corporation has been allowed a period of twelve months in which so to modify its plant that the damage complained of shall not be continued. The remainder of the paper dealt with a number of matters of detail, though nevertheless important, points, relating to various aspects of electricity supply, such as the replacement of apparatus on change of system, a standard hire and purchase agreement, supply of electricity in bulk, prepayment meters, &c. An interesting point that has to be settled is as to whether the Central Electricity Board in constructing its main transmission lines required for the inter-connection of selected stations shall bear the cost of the necessary switchgear. The position has arisen over a particular case—although it will arise in many as time goes on—of a Corporation whose station is a selected station and which has already existing switchgear designed to control the generating plant and outgoing feeders to meet all requirements for years to come, but not in contemplation of a connection to a main transmission line of the Board's system. The erection of the transmission line will call for switchgear of much higher disruptive capacity and at a cost of some £20,000. It was assumed that this cost would be borne by the Board, the gear being necessary for the control of the Board's transmission line. The Board, however, contends that the switchgear is required not for the control of its line, but for the erection of the Corporation's system, and therefore it is not prepared to provide and pay for the gear. The suggestion is that the technical experts of both sides will have to agree as to whether the switchgear in question is primarily "switchgear necessary to and used for the control of" the main transmission line within the meaning of Sec. 36 of the Electricity Supply Act of 1919.

(To be continued.)

Literature.

Exhaust Steam Engineering. By CHARLES S. DARLING. London: Chapman and Hall. Price 30s. net.

SINCE the nature and value of exhaust steam depends so largely upon the character of the prime mover by which it has been reduced to a lower condition, the question of its further utilisation can hardly be considered without reference to its previous history. The field of a book on exhaust steam engineering must, therefore, necessarily be wider than the title implies, and the author of the present work has taken full advantage of the latitude permissible. His main object, one gathers, is to emphasise the fact that in industrial plants where both power and low-grade heat are required, very large economies are usually to be obtained by the use of "pass-out" engines or turbines. The point cannot be made without demonstration by thermo-dynamics, so some of the principles of this subject are touched on in the opening chapters. The treatment is so condensed that no student could understand it unless his previous knowledge was sufficient for him either to do without it or to correct the regrettable faults and misprints which occur in it.

The value which the main portion of the volume possesses consists in the bringing together matters relating to the use of low-pressure, extracted or exhaust steam, which otherwise would have to be sought over a fairly wide field of literature. We have descriptions of various types of "pass-out" engines and turbines, and the gear necessary for them. The Still engine, the Brunler boiler, the Christiani-Diesel steam locomotive, the Rateau, Morison, Galloway, Ruth, and Duisburg systems of steam accumulators, the Drayton and Area systems of regulation, and the Mirrlees condensing, feed heating, and deaerating apparatus all receive attention. Piping and steam distribution systems for central heating also come under review, and one chapter deals with economic questions. The text contains a number of more or less worked-out examples, some of which are quite unconvincing. The reviewer has to confess to a definite failure to understand one purporting to show how "the waste of a condensing plant can be estimated," and another given to demonstrate the fact that if steam were required for both power and heating, it would be more economical to use the exhaust from a H.P. engine for the heat than to generate the heating steam separately. A little more care would have well been expended on these examples.

But the author appears to have written hurriedly throughout. We find a formula quoted as "a good American rule" for determining the efficiency of steam turbines at partial loads. Since a mere glance at it is sufficient to show that it would give efficiencies well up in the nineties, and therefore far higher than any turbine has yet attained or is ever likely to attain, one would have thought that the author would have been at least suspicious of it. The formula, as a matter of fact, does not refer to steam turbines at all, but is recognisable as one given by Messrs. Brown and Drewry some years ago in a paper before the A.S.M.E. as applicable to alternators driven by steam turbines.

An example to which we have referred above hints at the author's dislike of condensers, and one is tempted to wonder sometimes whether his thermo-dynamics are quite sound. In one chapter he appears to advocate a pass-out turbine which supplies steam to a process plant, and at the same time drives a compressor. The latter compresses steam in a closed circuit, taking the exhaust from "turbines of the usual type," and delivering it at a higher pressure to the turbine inlet valves. "The effect of this is that we have cut out the irreversible heat drop in the condenser." Further, "no condenser tubes are present to give trouble, and no horse-power hours are wasted in circulating water to waste heat. . . . For reconstruction of plant to suit higher boiler pressures this is a sound scheme. . . ." We can only say that we don't think it is. The compressor, piping, and secondary turbines form nothing more nor less than a costly, cumbersome, troublesome, and expensive kind of coupling between the primary turbine shaft and the machines driven by the secondary turbines. Electrical transmission would be vastly better, and it would equally avoid all condenser tubes and circulating water. The author's enthusiasm for "closed cycle steam plants" is great. Stand-by losses "almost nil," "no trouble due to boiler or condenser corrosion," "absence of condensers, circulating pumps, &c.," "exciting boiler only small," and "pressure range not limited by boiler construction," are among the benefits promised. But we find difficulty in understanding what the system is, or can be, supposing, of course, that its object is to generate power and that the laws of thermo-dynamics are not to be outraged. By some calculations which we totally fail to follow, the author arrives at an efficiency of something or other equal to 93·4 per cent., which is no doubt creditable. "The efficiency is due to the regeneration of the exhaust steam and the use of the kinetic energy in the exhaust." We must leave it at that.

The book is marred by a slipshod style and indifferent English. Misprints, too, for which the printers cannot fairly be blamed, are frequent, carelessness having been carried to excess with regard to the spelling of proper names. The book gives the impression of having been compiled in a desperate hurry, and without due care. The author is, we believe, a young man, and he has not yet acquired that skill in writing which may come to him in time. He will, perhaps, permit us to recommend him in future books to study clarity of expression, and if he cannot get someone else to revise his proofs, to read them with more care.

BOOKS RECEIVED.

How to Drive a Car. Eleventh edition. London: The Temple Press, 5–15, Rosebery-avenue, E.C. 1. Price 2s. 6d. net.

Motor Cycling Manual. Eighth edition. London: The Temple Press, Ltd., 5–15, Rosebery-avenue, E.C. 1. Price 2s. 6d. net.

Estimating. By T. H. Hargrave. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 7s. 6d. net.

The Railway Year Book for 1929. London: The Railway Publishing Company, Ltd., 33, Tothill-street, S.W. 1. Price 5s. net.

Universal Directory of Railway Officials, 1929. London: The Directory Publishing Company, Ltd., 33, Tothill-street, S.W. 1. Price 20s. net.

The Birmingham Exchange Directory of Members, Subscribers and Representatives, 1929. Birmingham: The Birmingham Exchange. Price 2s. 6d. net.

Transactions of the Fuel Conference, London, 1928. Three volumes. London: Percy Lund, Humphries and Co., Ltd., 3, Amen Corner, E.C. 4. Price £12 net.

Problems in Technical Mathematics. By A. H. Stuart, Ph.D., B.Sc. London: Oxford University Press, Amen House, Warwick-square, E.C. 4. Price 1s. net.

The A. T. M. Telegraph Engineers' Handbook. London: The Automatic Telephone Manufacturing Company, Ltd., Strowger Works, Liverpool. Price 2s. 6d. net.

"Proceedings" of the Institution of Mechanical Engineers, 1928. Vol. II., June–December. London: The Institution of Mechanical Engineers, Storey's-gate, S.W. 1.

Kelly's Directory of Merchants, Manufacturers and Shippers of the World, 1929. Two volumes. London: Kelly's Directories, Ltd., 186, Strand, W.C. 2. Price 64s. net.

Report of the Trials of the Combine Harvest-Thresher in Wiltshire, 1928. Bulletin No. 3. By J. E. Newman, assisted by J. H. Blacksby, B.Sc. London: The Oxford University Press, Amen House, Warwick-square, E.C. 4. Price 2s. 6d. net.

The Foundry Trades' Exhibition.

THE Foundry Trades' Exhibition, which was opened at the Royal Agricultural Hall, Islington, on the 5th inst. and remains open until the 15th, is a good demonstration of continental practice in the mechanical equipment of foundries; but it can hardly be said to be representative of British methods. There are altogether a hundred exhibits, and these include a number which are classed under the heading of machine tools and woodworking machinery. It is noteworthy in this section that foreign machinery is predominant and that a large number of firms which are not familiar at other engineering exhibitions have seized the opportunity of displaying their machines. This section, by the way, is housed in the Gilbey Hall and does not confuse the visitor intent on examining plant immediately associated with the foundry.

In the main hall there are some stands showing goods which are only indirectly associated with foundry work, but the majority are devoted to apparatus such as cupolas, sand preparing plant, moulding machines, sand blasting, and so forth. One of the most striking impressions which one gains in this section of the Exhibition is the influence of continental ideas on the design of foundry plant. There are, of course, a number of British firms among the exhibitors, but even on some of their stands this tendency is observable. It is also noteworthy that American machinery is not represented to any great extent, while some of the largest British firms have contented themselves with a display of specimens, such as fractures of pig iron, samples of metallurgical coke, &c.

There is, however, one section of the Exhibition in which the British element is predominant. It is the Technical Exhibit, which has been contributed to by various research associations, the National Physical Laboratory and some of the universities. This section is, of course, non-commercial in character and the material shown has been arranged according to a plan, so that as far as is possible similar subjects are grouped together. Thus, for instance, in one group one finds melting practice represented by refractories, specimens of fuels, and charts comparing the efficiencies of various cokes. Moulding sands and tests of their physical properties form another group, casting processes, the after treatment of metals, and so on, go to make other groups. It is one of the most interesting and instructive parts of the Exhibition. Associated with it there is an exhibit arranged to indicate the work being carried on in various countries in connection with the training of foundry apprentices, to which a large number of British institutions have contributed, while schools in France, Germany, America, and Belgium are represented.

It would be invidious in a brief notice of this kind to single out any of the exhibits in the commercial section for special notice, so we will content ourselves by saying that a very large proportion of the plant shown is concerned with the preparation and renovation of moulding sand. There is a fair sprinkling of cupolas and other furnaces, while moulding machines are found on several stands. In this connection it is noteworthy that pneumatic machines seem to be growing in popularity, as compared with hydraulic machines. It is also noteworthy that pressed steel flasks are ousting those of cast iron.

An inaugural luncheon was held in the Hall on Wednesday, under the chairmanship of Mr. H. Winterton, the President of the Foundry Trades' Equipment and Supplies Association. The principal guest was Sir Fortescue Flannery, whose health was proposed by Mr. H. G. Summerfield. Sir Robert Hadfield proposed "Success to the Exhibition," saying that there are produced in this country from 10 to 12 million tons of castings annually. He said that some of the best lessons which he had learnt in his early days came from the production of wasters. The response was made by the Chairman, who strongly advocated the purchase of foundry equipment of the most modern character, regardless of its country of origin, as, he said, with the assistance of proper equipment British foundrymen could easily surpass any others in the world. "Science and the Industry" was proposed by Mr. V. C. Faulkner and was responded to by Dr. W. Rosenhain; while "The Chairman" was proposed by Dr. R. S. Hutton.

Skoda Steam Turbines at the Ignat Colliery, Czechoslovakia.

CZECHOSLOVAKIA, which before the war constituted the principal industrial area of the old Austrian Empire, has greatly developed its manufacturing activities since it became an independent republic. The Skoda Works, formerly best known as one of the largest arsenals in Europe, were building machinery for peaceful purposes long before the war. Besides the ordnance for which they were famous, their range of manufactures included such articles as boilers, steam and gas engines, compressors and steam turbines, the latter having been a product of the firm since the year 1904, when a license was acquired to build machines under the patents of Professor Rateau. After the war special endeavours were made to enlarge the industrial side of the company's business. Among other things, the manufacture of electric generators, motors, transformers, &c., was undertaken, so that the Skoda Works are now in a position to construct complete power stations with all their steam and electric equipment. Their steam turbine practice has followed the Rateau system, with all its latest developments, and to illustrate it we propose to give a somewhat full account of the design of a pair of high efficiency turbines recently built by the firm for the Ignat Colliery in Czechoslovakia. The colliery comprises plant for the production of benzene and ammonia, in addition to the mine and coke ovens. The needs of the company for power were very considerable, so that in 1925 it was decided to put down a thoroughly modern and efficient generating plant. The prime movers were to consist of two steam-turbine sets, each having a capacity of 10,000 kW at 3000 revolutions. The order for these turbines and generators was placed with the Skoda Works largely on account of the good performance of a Skoda turbine supplied to the Trinec Ironworks in the preceding year. The latter machine was of the two-cylinder impulse type, with eighteen pressure stages in all, but for the Ignat turbines a three-cylinder construction was adopted as being more suitable to the special conditions obtaining.

Before proceeding to a description of the machines it will be well to refer briefly to these conditions. The steam supply for the turbines was dictated to some extent by the requirements of the by-product processes. The boiler plant comprises twelve boilers in all, six of them generating steam at 510 lb. gauge pressure and 750 deg. Fah. temperature, and the remaining six generating at 155 lb. gauge and 660 deg. Fah. Three of the high-pressure boilers have a heating surface of 6458 square feet each, and three of 5812 square feet each. The six low-pressure boilers, each with a heating surface of 3770 square feet, are fired by means of the waste heat from the high-pressure boilers. Half of the high-pressure and half of the low-pressure boiler plant was supplied by the Králové Hradec boiler shops of the Skoda Works. The steam from the high-pressure boilers goes directly to the main turbines. That from the low-pressure boilers has various duties. Some of it is used for driving the auxiliary turbines of the condensing plant, for operating the air ejectors, for driving the turbo-feed pumps, and for operating an air compressor. Some is also used in the ammonia factory, and the remainder is led to an intermediate stage of the main turbines. The benzene factory consumes a maximum of about 22,000 lb. of steam per hour, at 28·45 lb. gauge pressure. This steam is obtained by drawing it out of the main turbines at an appropriate stage.

The main turbines are thus driven partly by high-pressure steam and partly by low-pressure steam, while they pass out steam at a still lower pressure, before exhausting finally into the condensers. They are designed for a pressure of 455 lb. gauge and 707 deg. Fah. at the high-pressure stop valve, and for a pressure of 155 lb. gauge at the low-pressure inlet. The low-pressure steam supply varies from 13,200 lb. to 33,000 lb. per hour, while, as just mentioned, steam up to 22,000 lb. per hour is passed out at 24·5 lb. pressure. The condensers provide a vacuum of 94·1 per cent. (28·23in.) when supplied with circulating water at 77 deg. Fah.

The general appearance of the turbines, as viewed from each side, is illustrated in Fig. 1, page 628, and below; Fig. 2 shows the two sets under erection in the Skoda Works, and Fig. 3 is from a photograph taken above one of the sets with the top casings and rotors removed. These illustrations are sufficient to make clear the general lines of construction, while the longitudinal section reproduced in Fig. 8 shows most of the details of the design. An end elevation of the high-pressure end of the turbine, showing the governor gear, the four high-pressure steam admission valves, and the two overload valves, is reproduced in Fig. 5, and a drawing of the four pass-out valves with their gear, which are situated alongside the intermediate pressure cylinder, is given in Fig. 6. The turbine comprises in all twenty-three pressure stages, of which eleven are in the high-pressure cylinder, seven in the intermediate and the remaining five in the low-pressure cylinder. The final low-pressure stage comprises two wheels running in parallel, the steam being divided at the exit of the previous stage, and half of it passing round the casing so as to flow through the second wheel in the opposite direction. The three rotors are connected together by clutch couplings, the connection with the generator being made in the same way. The component parts of one of these couplings are shown in Fig. 7. The design permits of axial movement of the individual rotors as may be necessary under changes of temperature. The teeth of the couplings are annealed and machine-ground to form.

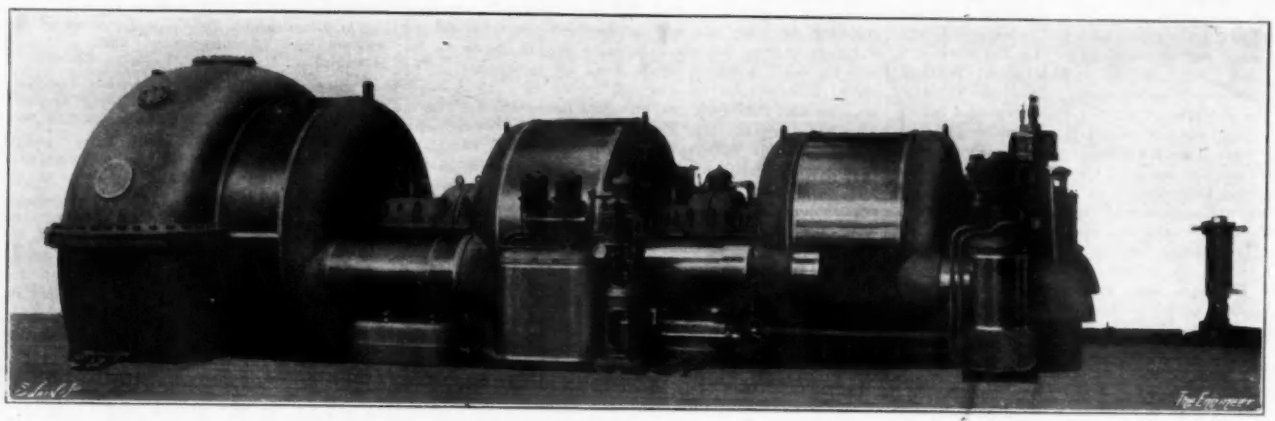


FIG. 4—10,000 kW THREE-CYLINDER TURBINE—LEFT SIDE

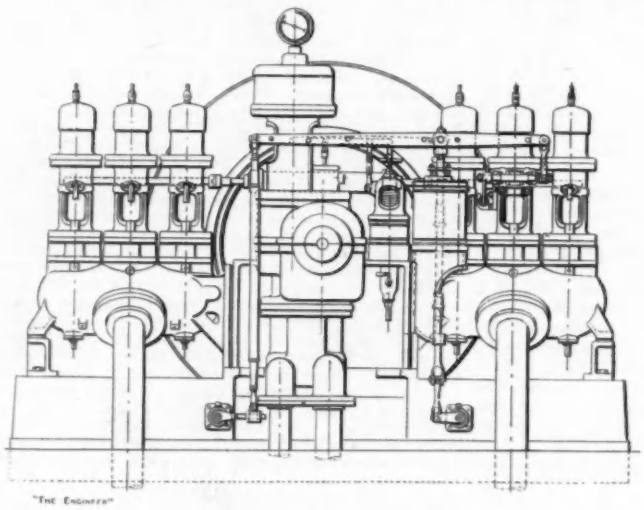


FIG. 5—HIGH-PRESSURE END

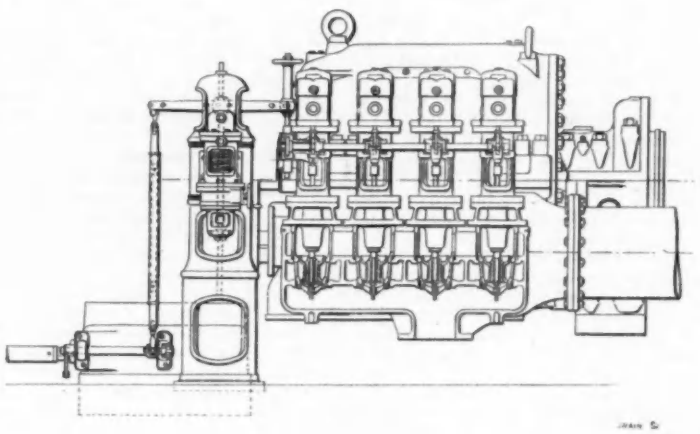


FIG. 6—PASS-OUT VALVES

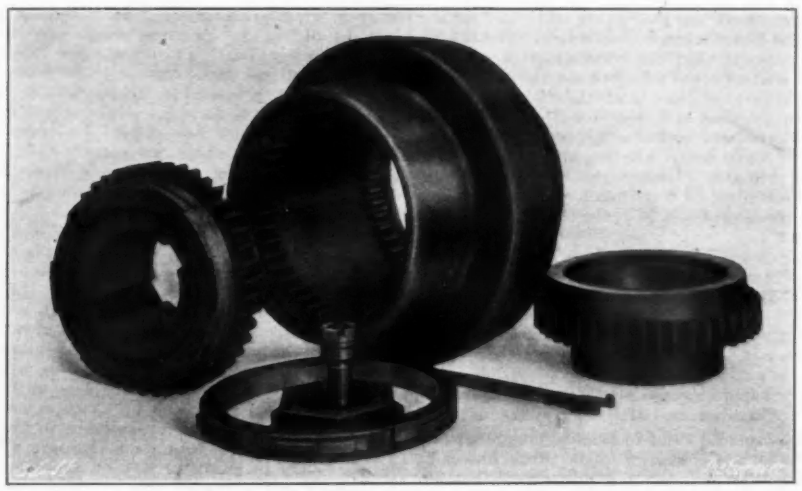


FIG. 7—COUPLING

10,000-kW. SKODA STEAM TURBINE FOR A COLLIERY

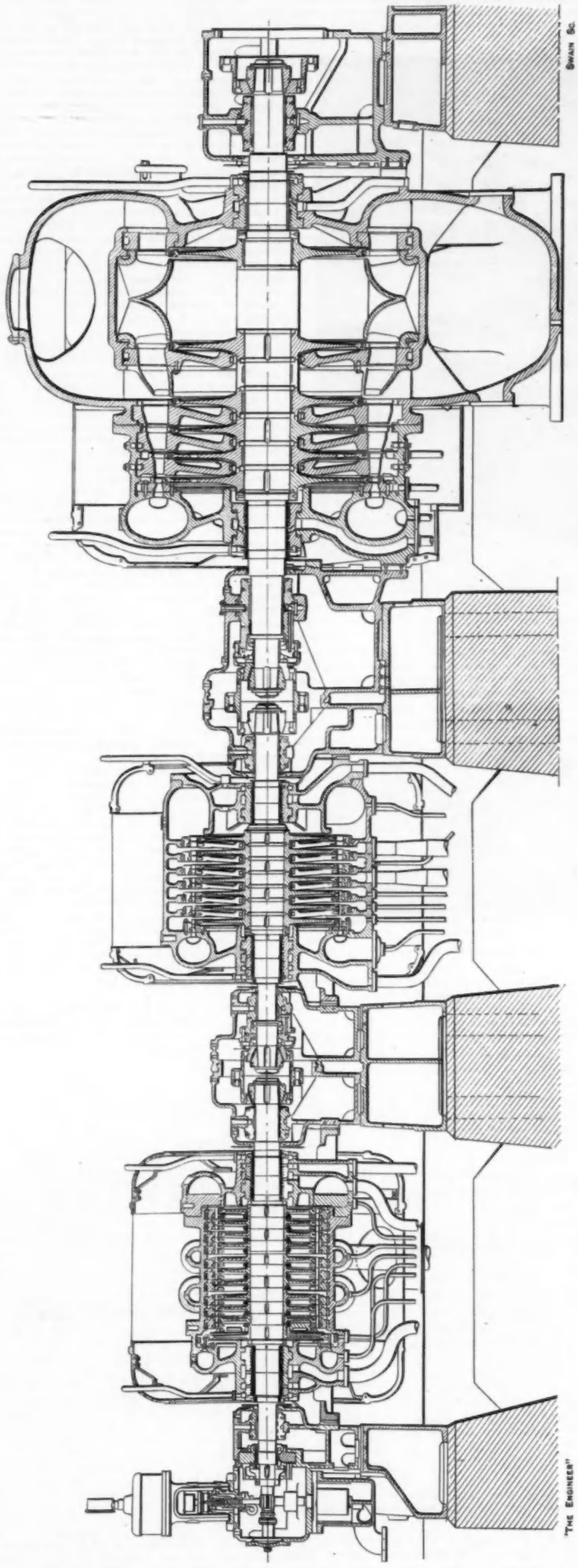


FIG. 8—LONGITUDINAL SECTION

The turbine shafts are forged from high quality steel and finished to size by grinding. Special steel is used for the wheels exposed to high temperature steam, and alloy steel for the low-pressure wheels, which are highly stressed, best open-hearth steel being employed for the intermediate stages. The wheels are, in general, secured to the shafts by rings on to which the wheels are pressed so that they do not exert any stress directly on the shafts. The rings are elastic in order to allow the wheels to expand independently of the shaft without losing their concentricity. Two feathers arranged opposite to each other transmit the torque of each wheel, the feathers of adjacent

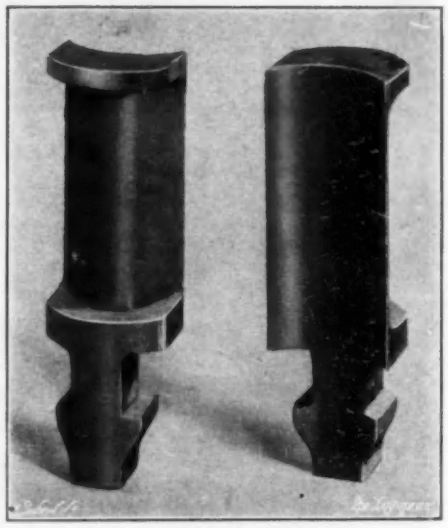


FIG. 9—H.P. AND I.P. ROTOR BLADES

wheels being set at 90 deg. to each other. Each wheel is balanced separately after the blades have been inserted and the shroudings ground.

The running blades are milled out of square rolled rods, the foot and the shrouding of each being solid with the blade itself. In the high-pressure and intermediate pressure rotor the blade roots are of T shape, as shown in Fig. 9, the last blade of each wheel being secured in the groove by two slightly tapered ground pins, a design adopted to avoid weakening the wheel at this point. The longer blades used for the low-pressure rotor have forked feet which straddle the wheel rims to which they

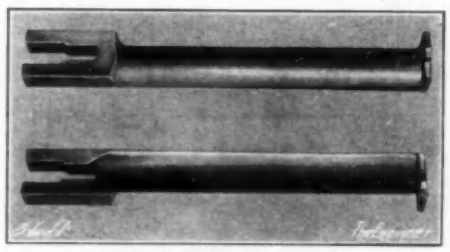


FIG. 10—L.P. ROTOR BLADES

are fastened each by a pair of rivets. The type of these blades is illustrated in Fig. 10, from which it will be seen that the shroudings interlock, the idea being to eliminate as far as possible the chance of vibrations of the blades. The sectional area of these blades is reduced from root to tip, so that the stress in the blade is almost uniform at any section, and the centrifugal force causes tension only without bending. Nickel steel is used for all blading except for the most highly stressed blades of the low-pressure rotor. These blades are made from a special steel having atensile strength amounting to 63·5 tons per square inch.

The nozzles for the high and intermediate pressure cylin-

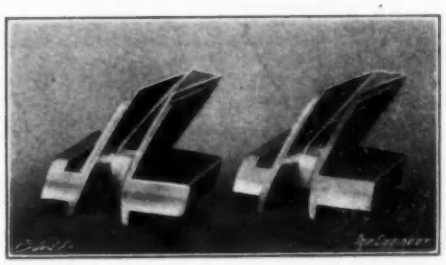


FIG. 11—H.P. AND I.P. NOZZLES

ders are also milled from the solid, the form adopted being illustrated in Fig. 11. The diaphragms between the stages are made in two parts, namely, a centre disc and an outside ring, both of steel, the nozzles being fixed in the annulus between them. The rings are under-cut on the outer circumference in such a way as to give them a flexible attachment to the internal ribs of the casings which hold them. The whole of the diaphragm and nozzles can thus expand freely without distorting the casing or being themselves distorted, remaining therefore concentric with the shaft and wheels and allowing the labyrinth packings at their centre to work under the best conditions. To assemble a diaphragm the nozzles are first of all inserted

one by one in the outer ring, and the central plate is then put into place and held to the nozzles by rivets; the diaphragm being, of course, made in halves, allows this easily to be done. The nozzles for the first stage of the high and the intermediate-pressure cylinders are made in exactly

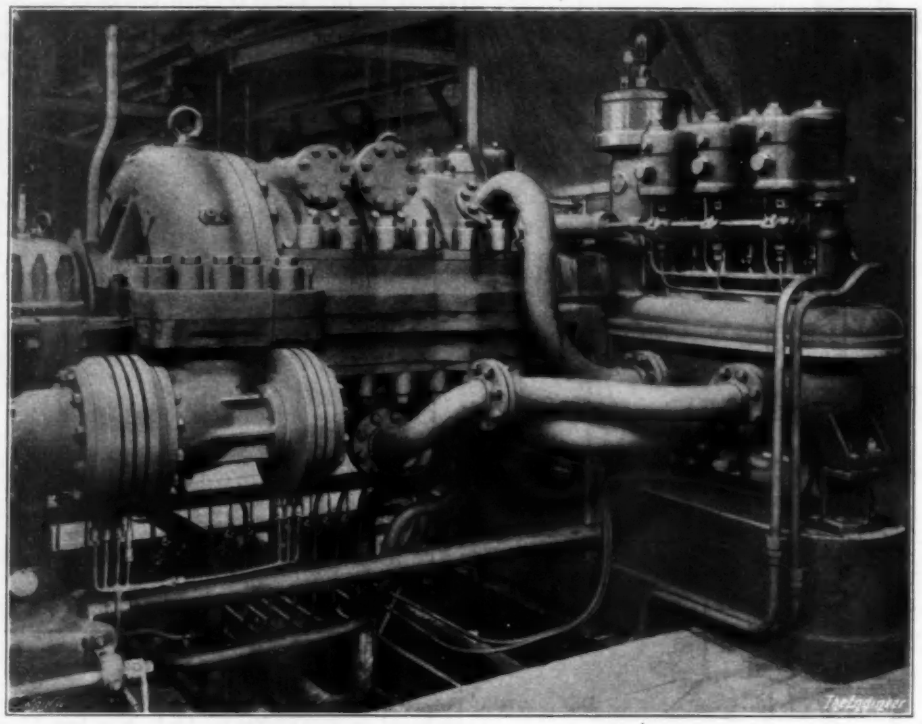


FIG. 12—H.P. CYLINDER, SHOWING VALVES AND PIPING

the same way as for the other stages, but the central disc of the diaphragms is, of course, wanting, and is replaced by a steel ring. The nozzles for the low-pressure part of the turbine are cast into the diaphragms, which in this case are of cast iron. These diaphragms are held into the

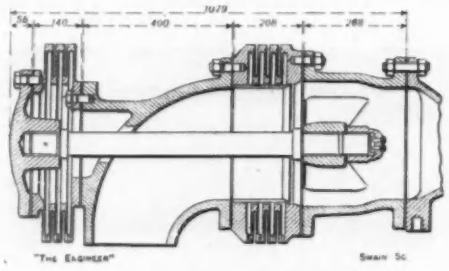


FIG. 13—EXPANSION PIECES

casing grooves by pins in such a manner as to permit of expansion.

Great attention has been paid to the reduction of internal losses in the turbine. Full admission is arranged for in all the stages, and the first wheel of the high-pressure cylinder is furthermore provided with fixed shrouding walls to reduce the fan action to the smallest amount. In order to reduce the losses due to wetness of the steam, the water is drained from every stage where moisture is present. The drops thrown off by the centrifugal action of the wheels arrive at the lower part of the casing by channels provided for the purpose, each stage being drained separately by an automatic float valve. The water is led to the lower part of the condenser where it mixes with the condensate. Its elimination as formed not only results in a higher efficiency of the turbine, but minimises the chances of corrosion or erosion of the blading and nozzles. All the turbine casings are divided horizontally, the joint faces being ground to ensure steam tightness. The high-pressure and intermediate-pressure casings are of cast steel, cast iron

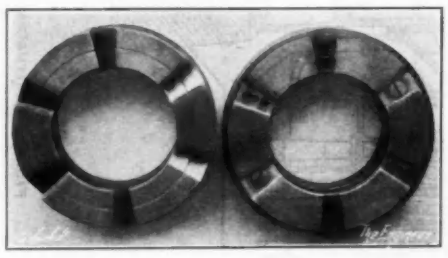


FIG. 14—THRUST COLLARS WITH SPRING PADS

being used only for the low-pressure casing, which is not subjected to any great pressure or temperature. The steel castings were all annealed after being rough machined, and all casings were tested hydraulically to a pressure never less than double that which they might have to stand under working conditions. The casings are without feet, being secured at the ends by the pedestal housings in which they are centred. The contact surfaces between pedestals and casings are kept as small as possible to avoid the transmission of heat.

The absence of feet permits of simple and symmetrical casings whose form is not likely to change with temperature. In accordance with the idea of simplicity of form, the regulating valves are made independent of the high-pressure casing. The valves themselves are vertical and arranged in a line at right angles to the turbine. Their chambers are fastened to the high-pressure pedestal at one end, and at the other they are freely supported on the frame of the machine, as clearly shown in Fig. 12. This illustration is also interesting, as showing the special method adopted for bolting together the two halves of the high-pressure casing. The casing in question is relatively small and the load to be taken by the joint bolts is considerable. Consequently a number of bolts too great to be conveniently accommodated in the usual manner has to be employed. In an ordinary row of bolts the minimum pitch is determined by the clearance required between the nuts to enable a spanner to be used. The number of bolts which can be accommodated can, however, be considerably increased by inserting alternate bolts from opposite sides and allowing each nut to be seated on the heads of the adjacent bolts. This is the arrangement employed by the Skoda Works for the flange joint of their high-pressure turbine. The bolts, as shown in Fig. 12, have square flat heads in contact with each other. The holes through the flanges are continued upwards through the bolt heads, half the hole in each head, so that the heads form seatings for the nuts of the intermediate bolts.

The steam is led from the high-pressure to the intermediate and to the low-pressure turbines by duplicate pipes connecting the lower halves of the casings. Dismantling the turbine is thus facilitated, for there is no heavy pipe work to be disturbed. The interconnecting pipes must admit of free expansion so that no undue stresses are imposed on the casings. They are therefore provided with expansion pieces. These latter consist of heavy blocks of steel with deep grooves cut internally and externally so as to provide a number of annular membranes. Two expansion pieces are visible in Fig. 12, details of the design being given in Fig. 13. The central bolt prevents end thrust, while the flexible pieces allow the pipe to have a movement relative to the casings. The casings are free to expand axially towards the high-pressure end of the turbine. The front bearing pedestal of each casing is so held that it can slide axially. Each rotor has two running bearings and a thrust block contained in the front pedestal. The thrust blocks are supported on spherical seatings in the pedestals. They are not fitted with pivoted pads, as in the Michell design, but a similar effect is obtained by undercutting the sections of the bearing surface so that they form pads flexible about one end. The idea will be made clear by reference to Fig. 14, which gives views of a ring with the springing parts. A smaller thrust block of the same type, but set in the opposite direction, steadies the machine axially and assures quiet running when the load is suddenly taken off.

The governor is of the vertical type driven by worm gear from the shaft of the high-pressure rotor. The turbine is controlled by the successive closing of nozzle groups. The valve admitting steam to each nozzle group is operated by an oil servo-motor, the action of the latter being determined by a cam shaft controlled by the main servo-motor. The cam shaft, governor and group valves are all shown in Fig. 12. By suitable arrangement of the shape and position of the cams gradual opening and closing of the valves is obtained. The use of an independent servo-motor for each valve has the advantage that the whole of the valves are closed practically simultaneously when the load is suddenly thrown off the machine, thus assuring safety in operation. There are four nozzle valves for high-pressure steam, and two overload nozzle valves, the latter being the outer valves of each group of three seen in Figs. 1 and 5. The overload valves admit steam to the fifth stage of the high-pressure cylinder. In addition to this provision for overload, high-pressure steam can be admitted to the eighth stage by means of a hand-operated valve.

As the turbine works with two pressures of live steam and steam is also passed out, the regulation is more complicated than is usual. With the object of avoiding un

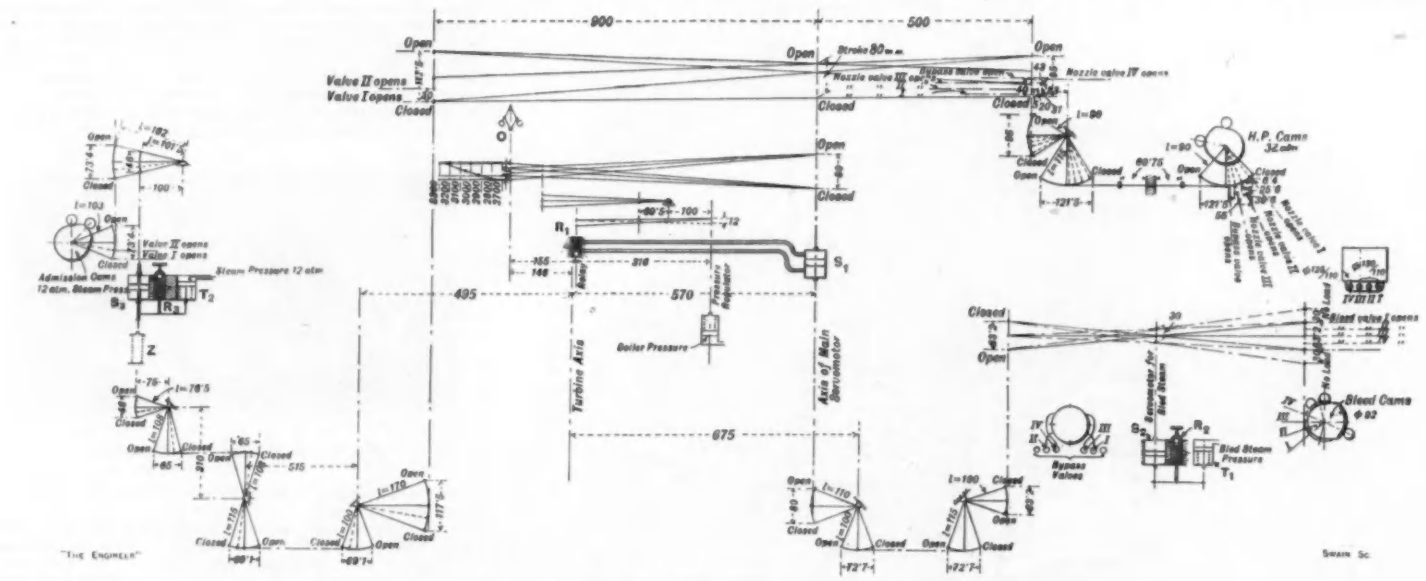


FIG. 15—SCHEME OF GOVERNING SKODA TURBINE

favourable throttling conditions as far as possible, provision is made for changing the point at which steam is extracted and also for changing the point at which low-pressure steam is admitted. This arrangement has the effect of allowing the main flow through the turbine to be

undisturbed, or nearly so, either by extracting or admitting steam along the turbine. Steam can be extracted at four places. It is always taken from that stage at which the pressure is slightly higher than the pressure required. The change in the place of extraction is controlled not only by the load on the turbine, but also by the pressure at which steam is extracted. Low-pressure live steam at 155 lb. pressure can be admitted at two different points, the place of admission changing according to the load on the turbine.

The system of governing is shown diagrammatically in Fig. 15. The main governor is indicated by the letter O. S_1 is its servo-motor, controlled by the pilot valve R_1. The pressure of the bled steam, acting upon the piston in the cylinder T_1, regulates the extraction by means of the pilot valve R_2 and the servo-motor S_2. The admission of low-pressure steam is correspondingly controlled by the similar apparatus T_2, R_3 and S_3. The piston-rod of the servo-motor S_2 is hollow and through it passes a rod constantly forced upwards by the spring Z, and tending to open the low-pressure steam admission valves. The opening of these valves is, however, limited by the servo-motor piston, the position of which is regulated by that of the pressure regulator T_2. The motion of the servo-motor S_1 is transmitted, on the one hand, to the live steam regulating valves, and, on the other, to the bleeding valves.

The governing mechanism has to deal with the following conditions :—

(1) The load and the quantity of extracted steam both being constant, the quantity of low-pressure steam admitted is varied. When the quantity of 155 lb. steam available falls off and its pressure is therefore reduced, the admission of this steam is checked and more high-pressure steam is admitted. For this action neither the governor nor the servo-motor S_1 come into use, and the speed of the machine remains unaltered, the link work being so proportioned that the total work done by high and low-pressure steam together is constant, in spite of alteration of their relative quantities. The pressures in the turbine change slightly, and to deal with this the pressure regulator T_1 either changes the point of extraction or opens the extraction valve wider. Should the quantity of low-pressure steam available increase the converse operations take place.

(2) When the load on the machine varies and the quantities of low-pressure steam admitted and extracted are unchanged an increase of load causes the piston of the servo-motor S_1 to rise, the servo-motors S_2 and S_3 remaining unaffected. The effect of the rise of the servo-motor S_1 is to open further nozzle valves for the admission of high-pressure steam and at the same time to alter the extraction point to a stage further up the turbine.

(3) When the load is constant and the quantity of extraction steam alone is altered, in this case the servo-motor S_2 is set in action by the pressure regulator T_1 and adjusts the extraction mechanism to the required position. The output of the turbine is prevented from altering by the governor O. As the quantity of extraction steam is relatively small compared to the total flow through the turbine, its alteration can be taken care of in the manner indicated without affecting the governing. In cases where a large amount of extraction steam has to be dealt with a mechanism similar to that employed for controlling the admission of low-pressure steam would be used. The extraction valves are of the double-beat partly balanced type.

The speed of the turbine can be raised or lowered by 5 per cent. for convenience in paralleling. The speed is altered by changing the position of the pilot valve R_1. The casing of this valve can be moved upwards or downwards by means of worm gearing, operated either by hand or electrically from the switchboard. Overspeeding is guarded against by an emergency governor on the end of the high-pressure rotor shaft, which comes into action when the speed rises to 10 per cent. above normal and trips an oil valve. The effect of this is to close instantly admission valves both for high and low-pressure steam.

The oil for operating the regulating gear and for lubrication is furnished by a gear pump at the base of the governor spindle. This pump delivers the oil under a pressure of from 30 lb. to 60 lb. per square inch to the piping for the regulating gear, and under a pressure of from 7 lb. to 20 lb. through a cooler to the bearings. From the bearings it flows through a filter back to the collecting tank. The temperature of the oil where it leaves the bearings is continuously indicated. When starting or stopping the turbine the bearings are kept flooded by an auxiliary turbine-driven centrifugal oil pump situated directly on the collecting tank.

The guaranteed steam consumption of the turbine when supplied with steam at a gauge pressure of 455 lb. per square inch and a temperature of 707 deg. Fah. at the stop valve, and exhausting into a vacuum of 28·23in. (bar. = 30in.) is 9·218 lb. per kWh measured at the generator terminals. This guarantee applies only when the turbine is running as a "straight" high-pressure machine at a load, of 7500 kW without the admission of auxiliary steam and without extraction.

SIXTY YEARS AGO.

THE movement in this country for the abolition of patents for inventions is not of such recent growth as some may perhaps suppose. There was a strong current of opinion in this direction sixty years ago. In our issue of June 4th, 1869, we gave a full report of a debate on the subject which had been initiated in the House of Commons by Mr. Macfie, the member for Leith. Mr. Macfie's resolution to the effect that the time had arrived when the interests of trade and commerce and the progress of the arts and sciences would be promoted by the abolition of patents for inventions was seconded by Sir R. Palmer and was supported, a little hesitatingly perhaps, by Lord Stanley. Mr. J. Howard, of the Bedford firm of agricultural engineers; Mr. Samuda, the Thames-side marine engineer; and others opposed the resolution. The reform of the patent laws, not the abolition of the granting of patents, was, they held, the right course to pursue. In that view we strongly supported them in the course of a leading article in the same issue. Writing with a freedom which to-day we could scarcely emulate, we implied that Mr. Macfie, a sugar refiner, had made his position mainly through the agency of patents and that his advocacy of the abolition of patents was dictated by his belief that he would have been wealthier if he had not had so many disagreeable royalties to pay. We treated Sir Roundell Palmer's and Lord Stanley's arguments for abolition less brusquely, but nevertheless described the proposal as childish and unpractical. That carelessness and ignorance characterised the granting of patents and the judging of patent cases was, we maintained, no ground for the total abolition of patents. It was the administration not the principle of the law that was at fault. There were, we said, people practising as patent agents who did not even know the English language, who scarcely knew a pump bolt from a cow's tail, and who had not the slightest idea of the laws, whether of patents, of mechanics or of common honesty. We agreed with Sir R. Palmer that patent litigation had acquired a reputation infamous beyond any other. The cases were tried before juries who knew nothing of the subject and before judges who imagined they knew all about it. The proceedings constituted in brief a series of dull yet enormously expensive farces. Nevertheless, reform of the patent laws was staved off year after year "till next session." It was not surprising, we concluded, that in these circumstances some people ignorant of technical matters should wish to abolish the law instead of trying to reform it. The system of granting patents might fail to secure the reward going to the right person, and might inflict inconvenience and injury on third parties. But the proposal to abolish patents and to substitute therefor an organised system of public rewards to inventors was impracticable, and might create greater evils than it was intended to avoid.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

INVENTION.

SIR,—"Boatman" in your issue of May 24th criticises my claim that the inventive faculty may be improved by the use of methods, and he supports the inspirational theory. This has many advocates, but may I suggest that it is based on a misunderstanding of the subject? Almost every other subject has been developed by the adoption of methodical analysis—science, art, music, bridge, and golf, to mention a few—and who will claim that we would be more advanced in any of these subjects if no one had ever tried to explore them methodically?

May I suggest two subjects which may be taken as samples for testing the value of method in invention—Sir Charles Parsons' recent paper on "Steel Purification," and the Wood boiler? Steel makers have been trying for over fifty years to get ingots of steel without flaws in the middle, by casting them vertically. Sir Charles Parsons showed that the flaws arose from the fact that the ingots were cast vertically and allowed to cool from the sides. He casts them horizontally and cools them from the bottom, keeping the top hot. This has given a new steel of a quality hitherto unknown. The paper is written so clearly that one may overlook the extraordinary skill shown in the investigations, but there is no overlooking the importance of the results. This invention comes under the head of Analytical and Change of Position Operators in my paper on "Invention." The Wood boiler, described in your issue of May 24th, also comes under the Change of Position Operator, seeing that the heating surface is placed round the furnace instead of above it, as in most water-tube boilers. It is also partly covered by what I have called the Increased Function, or preferably the Increased Duty Operator. The business of this is to suggest that any piece of apparatus which does a minor duty may be made to do a major duty. In the ordinary water-tube boiler, the side walls have the duty of keeping the flames in position, but in the Wood boiler they have the added or increased duty of absorbing the heat.

The day will come when method in invention will receive as much space in engineering papers as bridge problems now receive in newspapers. We have, in fact, only begun to invent, and I hope that the development of the idea of using method in invention will take place in Britain. The methods are not difficult to use, but, like golf and bridge, it is not possible to become expert without careful thought and labour.

C. TURNBULL.

North Shields, May 31st.

SIR,—Under the above heading "The Boatman" says that "even among accredited engineers the true significance of the word 'invention' is not properly understood; and a long experience of the ideas which are offered to the Patent Office as being 'inventions' that should be protected against infringement supports this contention."

If the Patent Office took the narrow view of the word "invention" that "The Boatman" takes, there would be very few patents granted and many devices, arrangements, designs, call them what you will, which should properly be and, in fact, are protected by patents would not be so protected.

Surely "The Boatman" is aware that, very often, the legal meaning of a word is not the same as the meaning which the word would bear if referred to its origin. Moreover, the ordinary "common usage" meaning, in the course of time, departs from the original meaning.

"Invention" may be said to have at least three meanings, that which it bears when referred to *in* and *venire*, which is the one to which "The Boatman" would confine it; that which it bears when used commonly as being an improvement; and that which it bears when used by the Patent Acts, Patent Office, and Law Courts, which is something between the other two.

I imagine Mr. Turnbull in the discourse to which "The Boatman" referred in his letter to you, published in the issue of THE ENGINEER for May 24th, 1929, used the word "invention" in its intermediate sense.

THOMAS SHERRATT, A.M.I.E.E.

London, S.W. 2, May 28th.

THE EDUCATION AND TRAINING OF ENGINEERS.

SIR,—The leading article entitled "The Economics of Education" in your issue of May 24th ought to be printed in the general Press, and not only in a technical journal, where it is not likely to be seen by the person chiefly interested. Among all the pother about education for engineers, there is one person who seems to get very little consideration, and that person is the parent of the embryo engineer. No reasonable man, whatever his views may be on education in general, can blame a parent if he regards money, his money, spent on technical education, as an investment. Now, a parent who has obtained advice from engineers and teachers of engineering can only come to the conclusion that the best training he can give his son will include school till seventeen, then an apprenticeship of three or four years and a three years' course at college. That is to say, he is asked to contemplate spending as much as he would have to spend were his son to take up medicine and train at one of the newer universities. In such circumstances the parent will want to know whether engineering offers prospects equal to medicine. Can any engineer who has been through the mill say that the normal prospects, financial, social, and so forth, are as good for an engineer as for a medical man?

In the first place, an engineer has practically no prospects of establishing himself as an independent professional man. The large manufacturing concerns do all the consulting engineering that is wanted, for nothing, and it is almost certain that an engineer will remain a wage earner or salaried man.

If he has been to college he will have no taste for early rising, and will probably drift into a drawing-office where at the age of twenty-four or twenty-five his prospects (I speak, of course, of the average) will be about equal to those of a youth of the same age who entered a bank or an insurance company at seventeen, except that he will not have the same security of his job nor will he have a prospect of a pension if he hangs on.

What many parents do not know is that in an engineering works the proportion of jobs which carry a salary exceeding £500 per annum is exceedingly small, and consequently only a small proportion of those at any moment undergoing training can get one.

There is a tendency at present to teach everything in colleges rather than at the job, and behind this tendency there is a fallacy. The fallacy is simply this, that people are paid highly for what they know. In an industrial concern they are not, they are paid for what they do, and if the concern is properly organised what they are called upon to do is simple, easy and monotonous, but it has to be done and done regularly, conscientiously, and over and over again.

Colleges concern themselves almost exclusively with design, and another thing parents do not know is that the demand for designers is small. It is no exaggeration to say that most engineering concerns never have had, and never will have, any need for the services of a single designer.

In conclusion, may I say that I have no intention of belittling my profession, but I do feel that there is a want of proportion between the kind of job mechanical engineering really is, and the long and expensive training which is so frequently advocated. Three years at college with all it means in fun and interest is a delightful thing to have, but candidly the engineer cannot afford it.

Manchester, June 3rd. A. C. WILSON.

GRAND JUNCTION LOCOMOTIVES.

SIR,—I am anxious to obtain some reliable information about the engines of the Grand Junction Railway, numbered 65 to 88, that is to say, after Whishaw's list, published 1840, and shall be grateful to any of your readers who can help me.

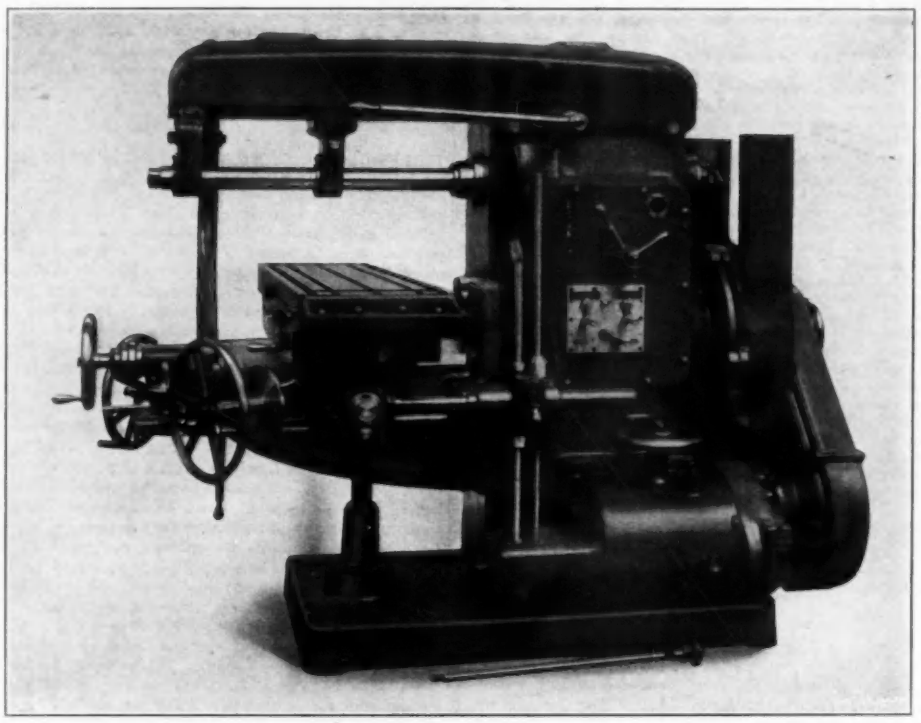
C. F. DENDY MARSHALL.

Wonersh, June 5th.

A CO-OPERATIVE arrangement for the study of the removal of ash as molten slag from powdered-coal furnaces has been entered into by the United States Bureau of Mines, Department of Commerce, and a special research committee appointed by the American Society of Mechanical Engineers. This subject is important because of the serious problem of the disposition of the ash from high-ash coals burned in pulverised form. If the ash can be run off in a molten condition the problem would be greatly simplified. The investigation is intended to obtain data on the factors that influence the formation of fluid slag in furnaces, the means by which fluidity may be measured, and the proportion of total ash in coal which remains in the furnace. Laboratory work in connection with the investigation will be done at the Pittsburgh, Pa., Experiment Station of the Bureau of Mines, while actual operating tests will be conducted at plants designated by the American Society of Mechanical Engineers.

HIGH POWER PLAIN MILLING MACHINE

ALFRED HERBERT LTD., COVENTRY, ENGINEERS



A High Power Plain Milling Machine.

THE high power plain milling machine illustrated herewith represents a design, the earliest example of which was shown by the makers, Alfred Herbert, Ltd., of Coventry, at the Olympia Machine Tool Exhibition last autumn. The design with certain improvements embodied in it is now about to be placed on the market.

The general objects aimed at in the design of the machine were the attainment of high power and great rigidity, combined with ease of handling and the provision of rapid power traverses for the idle motions. The column is a single box-sectioned casting, and is bolted to the base plate. On its top the column is formed with a dovetail guide, in which the box-sectioned overhanging arm can be moved in or out by a rack and pinion gear. Two large bolts passing horizontally through the column are provided to clamp the arm in any position. It is claimed that this design of arm is particularly well adapted to resist the combined torsional and bending stresses thrown upon it by the reaction of the feed. On the front of the column a long bearing is provided for the knee carrying the saddle of the work table. A taper gib moved endwise by means of a long lever and a rack and pinion is employed to lock the knee to the column. The overhanging arm and the knee are tied together by an offset arm brace. This brace, as shown in the front end view, is supported from the top surface of the knee, and is connected to the overhanging arm through the intermediary of an arbor support, which fits on to the dovetail guides on the underside of the overhanging arm. It will be seen therefore that the column, arm brace and knee constitute parts of a structure which can be locked together to form a rigid whole. It is claimed that the arm brace is of sufficient strength to provide a rigid support for the arbor, even when the overhanging arm is removed. The off-setting of the brace is intended to remove it out of the way of the operator. In addition the offset enables large cutters to be removed from the arbor without disturbing the brace. The brace may be used on either side of the arm as convenient. In addition to that carried by the brace, the overhanging arm is provided with two arbor supports, which can be clamped to the dovetail guides. One of these intermediate supports is equipped with a parallel white metal adjustable bearing, and the other with two adjustable bronze shoes.

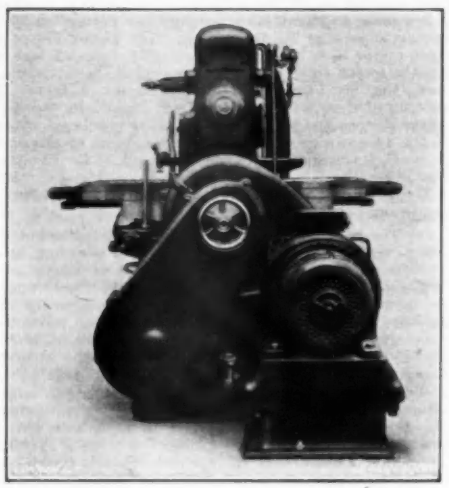
The machine is driven by means of a single belt pulley, which runs on ball bearings on a fixed sleeve arranged in such a way as to relieve the driving shaft of the belt pull. The drive is transmitted through a friction clutch operated by a starting and stopping lever near the head of the column and arranged to be easily reached from either side of the knee. Alternatively, as shown in the rear end view, the machine may be arranged for an individual motor drive. The motor in this case is mounted on a stand resting on the foundation and connected to the column base. The drive from the motor is transmitted by a totally enclosed noiseless chain running in an oil bath.

The spindle is provided with the new international standard nose with a tapered hole and has provision for the attachment to it of large inserted tooth cutters. It runs in white metal bearings and is reversible. Two drawbolts and an adapter for taking taper-shanked cutters, collets, &c., are provided.

From the clutch power is transmitted through a driving box built as a separate unit, and fixed in the side of the column. Sixteen spindle speeds, ranging in geometrical progression from 16·5 to 427 r.p.m., are obtainable by means of sliding gear wheels. All the wheels and bearings inside the driving box are continuously flooded with oil delivered from a pump inside the column. This pump also automatically lubricates the feed-box.

The knee slide carrying the saddle is formed with square edges and a narrow central guide, which is provided with a taper gib. The saddle is held down to the knee by means of two gibs at the outer edges, and is clamped along both edges by independent tapered gibs, which are operated through hand levers situated at the front of the saddle.

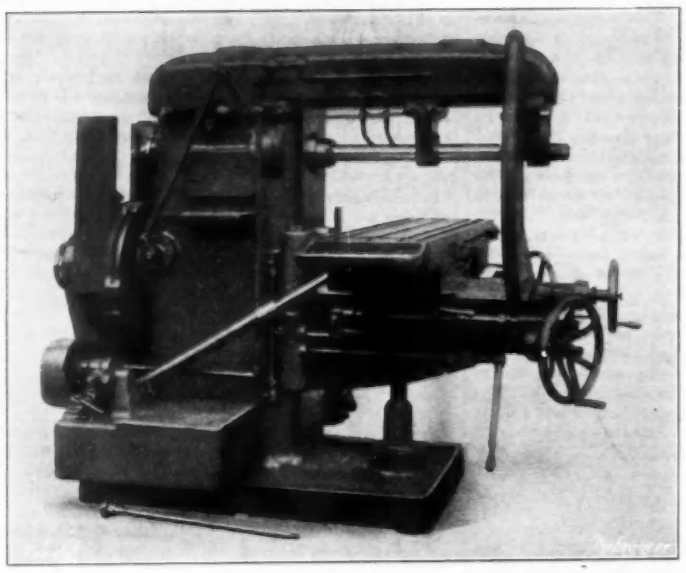
The table is actuated longitudinally on the saddle by means of a quick pitch, stationary, non-splined screw, which is always in tension and a long phosphor bronze nut rotated by steel spur gearing and fitted with ball thrust bearings at both ends. To meet special requirements, an extra long table can be fitted to the saddle of standard width or, alternatively, an extra wide table can be fitted to a saddle of extra width and standard length.

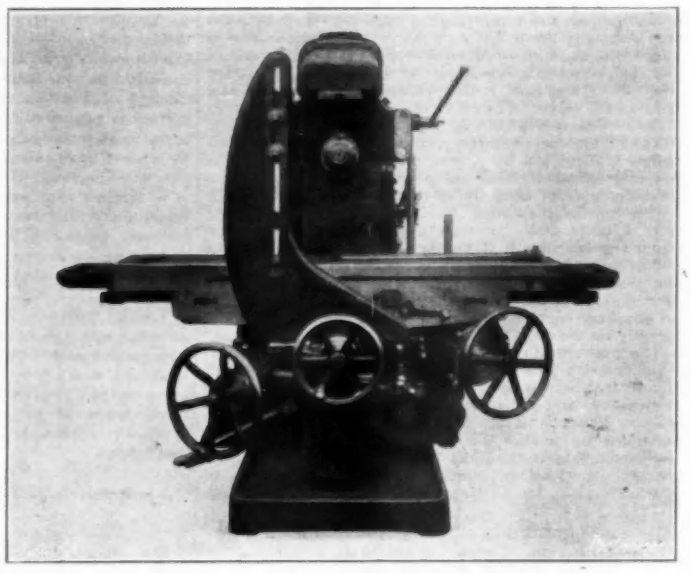


MACHINE FITTED WITH MOTOR DRIVE

The automatic feed motions are obtained from a feed-box of the maker's patented dial feed type, mounted on the side of the column beneath the driving-box. This box gives eighteen different rates of feed, ranging from $\frac{1}{2}$in. to 22$\frac{1}{2}$in. per minute, the required feed being obtained by simply rotating a hand wheel and dial until the feed desired, as marked on the dial, comes opposite a pointer. The feed-box is driven by belt from the first driving shaft. By the use of a belt for this purpose safety is secured without resort to the employment of shearing pins or other troublesome device. At the front of the knee there is a handle which when moved in one direction engages the automatic cross feed of the table, and when moved in the other engages the automatic vertical feed of the knee. A second lever at the front of the knee reverses the direction of all the feeds. The vertical movement of the knee and table is obtained by means of a screw which is made telescopic in order to avoid the necessity for cutting a hole in the floor. Quick power motion at 150in. per minute is provided for the longitudinal movement of the table. This motion is independent of the longitudinal feed motion, and is controlled by a lever at the operator's right hand, which is moved in the direction in which it is desired to make the table travel. When quick power motion is required in the vertical or cross direction, the fastest feed is employed, the rate of which is rapid enough for either of these comparatively short travels. All the feeds are fitted with automatic stops and safety stops.

Each part of the machine likely to prove a source of danger to the operator is guarded. All the gearing is covered and the main and feed pulleys are provided with belt guards. A vertical milling attachment, as illustrated herewith, can be fitted to the spindle to work in conjunction with or apart from a circular table attached to the main table. The vertical milling attachment can be inclined against a graduated base. The circular table is

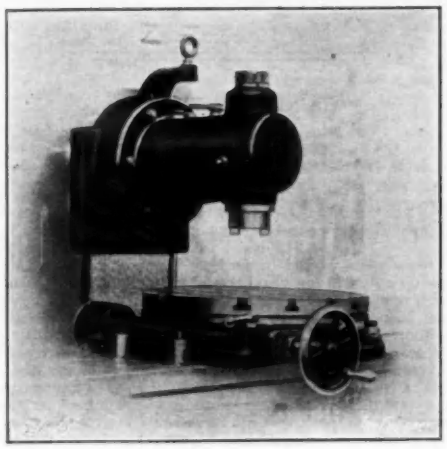




REAR AND FRONT END VIEW OF BELT-DRIVEN MACHINE

provided with hand and automatic feed movements and automatic stops. Its edge is graduated in order that the table may be set to any angle against an adjustable pointer.

The standard table has a surface of 68in. by 17in., and can be given automatic feeds through a range of 48in. longitudinally, 18in. transversely, and 22in. vertically. If the machine is so required, it may be fitted with an extra long table, having a working surface of 90in. by



VERTICAL MILLING ATTACHMENT

17in., and a longitudinal feed of 70in. It may, alternatively, be fitted with an extra wide table measuring 68in. by 24in., in which case the normal transverse feed is reduced to 11in. For medium work the machine requires about 15 horse-power for its drive.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

THE change in the Government of the country has upset the plans of many Midland industrialists, and on 'Change in Birmingham to-day—Thursday—iron and steel manufacturers and engineers sought to fathom the effects of the change as applying to their own particular cases. Staffordshire industries are likely to be greatly affected by any change in the Safeguarding of Industries Act, and automobile engineers and manufacturers of hollowware, to name only two sets of industrialists, express great perturbation lest their trades should suffer a reverse just when they are beginning to make headway. They hesitate to make arrangements for the supply of material for use in their works, and although they realise that business must go on and output be continued, they see the necessity for acting cautiously. There can be no doubt that, at any rate so far as this week is concerned, business has been seriously interfered with. There has been no change of note in prices. It is much to be desired that business should be got on the move again, and Midland industrialists will not be backward in adapting themselves to the changed circumstances and in putting forth every effort to keep British trade progressing in the right direction.

The Rise in Pig Iron Prices.

The advance of 1s. per ton in Midland brands of pig iron last week came as a surprise to the market. It was known that blast-furnacemen in this district were anxious to obtain better prices for their iron, but it was not foreseen that they would put prices up again so soon after the recent rise. Smelters had been saying for some weeks that values were more likely to advance than recede, and the increase in production costs, coupled with the relatively good prices being obtained by Cleveland makers, evidently so weighed with them that they were persuaded the time was opportune for a further advance. This was in spite of the fact that since the previous rise was announced consumers have stubbornly stood out against the higher prices. They have carried on as far as possible with the pig iron contracted for when the market was at a much lower level, and when forced to buy they have limited their purchases to absolute requirements. Some of them offered to do business at slightly below the current rates in the hope that furnacemen would think it worth while to give way, but these attempts to beat down the price proved unavailing. Midland smelters are generally influenced to some extent by the price of Cleveland iron, and in that district the stringency of the market has caused values to rise sharply, so that the Midland advance brings a closer relationship between this district and the North. In addition, furnace coke is comparatively high in price, and on this ground alone the pig iron makers considered themselves justified in making the advance. This week business has been quieter than ever, being more or less at a standstill. Odd lots for prompt delivery have been bought at the new price, but it is reported that smelters are not now disposing of the whole of their output. Demand is equally quiet in the forge and foundry branches of the trade.

Blast-furnacemen and the Merchants.

The deputation of merchants who have been placing their grievance before Midland smelters, referred to previously in this column, report that the latter are prepared to concede a commission of 1½ per cent. on sales of pig iron to merchants, free on train prices to be the basis. This, it is understood, works out at about 11d. per ton, as against 9d., the amount originally fixed by the blast-furnacemen. Exactly what the merchants think of this latest offer it is difficult to determine, but it is significant that they have formed themselves into an association for the promotion of common interests.

Steel Demand.

While some branches of the steel trade are decidedly busier, others are but moderately employed. A good deal of special steels used in the production of motor cars and commercial vehicles is being called for by manufacturers in this area, who are also absorbing very fair quantities of stainless steel. Heavy steel for structural purposes is quiet. Mills have moderately good order books, however, and they are in a position to supply most descriptions of material promptly, so that they often secure small orders required urgently which under other circumstances would probably go to their competitors. Very few large contracts for heavy steel have been given out since the prices of sections, joists, and plates were advanced, but some encouraging inquiries have been in circulation. Uncontrolled steel is firm in price, and output is maintained at recent levels. Small steel bars are quoted £6 7s. 6d. upwards and English billets £6 12s. 6d. per ton. Offers of foreign joists and other building steel continue to be made, but little is being bought, at least so the Birmingham merchants say. Continental steel strip is perhaps the best foreign seller in this district just now. Large quantities of strip are used at local works, and there is an appreciable saving to be effected by the use of foreign material.

Staffordshire Iron.

The finished iron trade in Staffordshire pursues an even course. There is little, if any, change in the volume of demand from recent weeks, and prices continue unaltered. There is, of course, ample room for improvement in business in this department, but manufacturers are in a better position than they were, and are slowly gaining ground. The rising cost of materials is causing some concern, and there are those who favour a revision of finished iron prices to meet the new production costs. A move in this direction in the near future would not occasion surprise. Marked bars are quoted this week £12 per ton, Crown bars £9 10s. to £10, nut and bolt and fencing bars £9 to £9 2s. 6d. The district works consuming the latter class of material are just now doing more work, but unfortunately for Staffordshire ironmasters they are able to secure supplies of Belgian No. 3 iron at so low a figure as to make it extremely attractive. The steely character of this material is outweighed by price considerations. Wrought iron gas tube strip sells at £10 17s. 6d. and is in constant demand. A larger proportion of iron strip is now being used by the tube works, and this tendency is expected to increase. Ironmasters re-rolling steel are busy.

Scrap.

The steel scrap position is now much easier, and ample supplies are available. In these circumstances sellers are no longer able to command the abnormally high prices obtainable a few weeks ago. Whereas a week ago sales were effected at £3 17s. 6d. delivered South Wales, they are now being made down to £3 15s. In some cases a midway figure applies, but, generally speaking, buyers are able to secure concessions on the quoted rates of £3 17s. 6d.

Galvanised Sheets.

Business in galvanised sheets remains quiet. Orders are fairly regular, but are of comparatively small size. Demand neither for home nor export shows much life. Local mills have moderate order books, and mills are regularly employed. Values of 24 gauge corrugated sheets are unchanged at £13 12s. 6d. to £13 15s. per ton. Black sheets are in good request, and prices are firm.

Coventry Engineering Works Strike.

At the time of writing a strike is in progress at the works of the Sir W. G. Armstrong Whitworth Aircraft Company, Ltd., Coventry. Some 150 men who were engaged in the construction of steel aeroplane wings are concerned in the dispute, which relates to the price to be paid for work on a new type of steel aeroplane wing. At the moment there is a deadlock, the firm maintaining that work must be resumed before negotiations can be begun, and the men refusing to restart until the matter is settled.

Contracts for Midland Firms.

Some very useful orders have been received by Midland firms from the Crown Agents for the Colonies on behalf of the Tanganyika Railways. They include a 100 H.P. double-geared 21-ton shunting locomotive, to be made by the Sentinel Waggon Works, Ltd., Shrewsbury; and a 2–6–2 tank locomotive, to be made by W. G. Bagnall, Ltd., Stoke-on-Trent. The Gloucester Railway Carriage and Wagon Company, Ltd., is to supply four four-wheeled brake vans, and the Metropolitan Cammell Carriage Wagon and Finance Company, Ltd., of Saltley, Birmingham, ten bogie covered goods wagons.

Cannock Chase Coalfield.

There has been a steady decline in the coal-mining industry in the Cannock Chase and Pelsall area during the past month, and, as a result, there is a fall in the wages of miners. The ability of the coalowners to pay, which in May was 51·24 per cent. on the 1911 basis, has dropped to 45·24 per cent. The minimum wage of stallmen will therefore decline from 9s. 11d. to 9s. 6d., with a proportionate amount for other workers. Last month's rate, it will be remembered, was the best since June, 1927. During April there was a loss of 9¼d. per ton on all coal raised in the area, compared with a profit of 2s. 8·07d. in March, and 3s. 2¼d. per ton in February. A further reduction in miners' wages in July is anticipated. Indeed, it is probable that they will return to the minimum of 9s. 4d. per day for stallmen.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Foreign Competition in Wire Trade.

BRITISH wire rollers and drawers are feeling very keenly the effects of foreign competition. The position from this point of view was discussed at some length by Major E. Johnson, who presided at the annual meeting here of Richard Johnson and Nephew, Ltd., an old-established concern engaged in the rolling and drawing of iron, steel, copper and other metals. Founded as far back as 1773, the company was converted into a private limited concern in 1900 and was floated as a public company in May of last year. From the date of incorporation—May 28th, 1928—to the end of March last, the period covered by the first annual report, the net profit amounted to £37,056, and dividends at the rate of 7 per cent. on the preference shares and of 8 per cent. on the ordinary shares have been declared. Competition with foreign makers, said Major Johnson, was especially keen, and the comparatively low wages paid abroad enabled them to manufacture at a much lower cost than in this country, and to export to the British market a tonnage of wire and wire manufactures approximately equal to 50 per cent. of the total production of wire in this country. Consequently, it was only by maintaining quality that British manufacturers could hope to retain their markets.

Power Developments.

Interesting details relating to developments at the Radcliffe, Padiham and Kearsley electric power plants of the Lancashire Electric Light and Power Company were given by Mr. A. Shepherd at the annual meeting of the company this week. The maximum load in kilowatts at the Radcliffe Station has risen from 48,200 to 51,400, and at Padiham from 13,000 to 16,500. In the returns of the Electricity Commissioners for the year ended March 31st, 1928, Padiham has been placed at the head of the list for low coal consumption among stations of all sizes, and in respect of thermal efficiency second only to the Manchester Corporation's Barton Station, the figures being Padiham 21·03 per cent., and Barton 21·07 per cent. The company's 11,000-volt system has been increased by about six miles, and its 2000–3000-volt mains by nearly eight miles, the greatest activity having been in connection with the low-tension supplies, where over 48 miles of new distributing mains have been provided during the past year. The current sold increased from 175,433,756 units in 1927 to 206,608,808 units last year. Under the North-West England and North Wales power scheme, the company's three stations have been selected, and it is expected that both Kearsley and Padiham will be operated as base-load stations, in which case some extension of boiler plant at both stations will be necessary. The complete scheme for the Kearsley Station, which is in course of erection, consists of four units of 42,000 H.P. each, and it is anticipated that the first two units will be in operation in the coming autumn.

Fleetwood and a Transporter Bridge.

A scheme for the construction of a transporter bridge across the mouth of the river Wyre at Fleetwood with the object of doing away with the existing steam ferry service has been before the Town Council, but further consideration of the matter has been postponed *sine die*. It is estimated that the cost of such a bridge, which would have to be about 1400ft. in length, would be in the neighbourhood of £200,000, apart from the cost of providing suitable approaches at both sides of the river. Although the scheme has been virtually abandoned so far as the Council is concerned, there is some talk of a private company being formed to carry it out if the steam ferry rights, which are owned by the Council, can be acquired.

£193,000 for Turbo-alternator.

The tender of the Metropolitan-Vickers Electrical Company, Ltd., Manchester, for the supply of a 50,000-kilowatt turbo-alternator at a contract price of £193,370, in connection with the new power station which is to be constructed on the site of the old Clarence Dock, Liverpool, has been recommended for acceptance by a special committee of the City Council.

Increased Capital.

The directors of Ferranti, Ltd., electrical engineers, Hollinwood, Lancashire, propose to capitalise £40,000 of reserves by distributing two new shares for every three held by ordinary shareholders. These ordinary shares are privately held. The total issued capital of the company will be brought up to £246,166.

Non-ferrous Metals.

Except for a slight loss in the spelter section, price conditions on the non-ferrous metals market during the past week have been steadier than of late. In the case of copper the movement of the metal on the standard market has been moderately active, although there has not been a great deal of business done during the week in refined metal so far as the cable manufacturing industry is concerned. With regard to prices in this section of the market renewed steadiness has been in evidence after the weakness referred to a week ago. It has amounted to no more than about £2 a ton, however, for standard cash, and there is no sign whatever at the moment of prices soaring again to the levels that were current about ten weeks ago. With regard to tin, the demand this week has been by no means active, but a somewhat more "bullish" tone has developed, partly, perhaps, in consequence of declining stocks of the metal in this country.

Although still, at the moment of writing, below the £200 mark current quotations are about the highest that have been registered since the last week in April, values being nearly £3 a ton above the levels ruling a week ago. Only a moderate trade has been done in both spelter and lead. The latter has, however, been about maintained, although in the case of spelter there has been a slight loss on balance.

Iron and Steel.

New orders on the pig iron market here this week have virtually been confined to one or two contract renewals to replace those that are on the point of exhaustion. A satisfactory feature of the situation, however, is that Lancashire foundries, although conditions are by no means uniformly good, are taking regular deliveries of material. Quotations are firm at 73s. per ton for Staffordshire No. 3 for delivery to users in the Manchester zone, with Derbyshire brands at 1s. a ton less. The demand for Scotch iron is relatively slow, although prices are maintained at about 91s. per ton, delivered Manchester. A quietly steady business is being done in hematite, with West Coast makes quoted for delivery in this area at 87s. per ton. Cleveland iron is not on offer here, and values are purely nominal at about 83s. per ton delivered Lancashire. Inquiry for bar iron is still on moderate lines, but quotations in this section keep very firm at £10 10s. per ton for Lancashire Crown bars and £10 for seconds. There has been no improvement in the demand for heavy constructional steel on this market, and few Lancashire firms can be said to be satisfactorily engaged. Locomotive engineers are specifying for fair supplies of plates and other materials, and there is a moderate miscellaneous business being done in steel for the general engineering industries. With regard to prices, these keep very firm at £9 17s. 6d. per ton for acid boiler plates, and £9 12s. 6d. for basic kinds, £8 17s. 6d. for general plates, £8 2s. 6d. for joists and sections, £9 2s. 6d. for large bars, and about £8 10s. per ton for small re-rolled bars.

BARROW-IN-FURNESS.

Hematite.

The improved condition of the hematite pig iron trade is maintained, and makers are well circumstanced for orders. The amount of business on home account is very satisfactory, and there are signs of the demand being continued. The local steel departments are taking a fair tonnage every week, and this affects the market to the extent of limiting the amount available. There is a good demand for special qualities, and there is a steady trade overseas in the better brands of iron. There was some talk of another furnace being put into blast, but nothing has come of it as yet. There would appear to be scarcely sufficient justification for increasing the output at present. If the steel trade were guaranteed a long steady run then things might be different. As it is, makers are well covered as regards their present output. The iron ore trade is a little better as a result of the transaction of more business in native sorts with iron makers outside the district. The local demand is steady. The demand for foreign ore remains about the same. The steel market is moderate with a few orders available. Competition is keen, and on the big contracts the prices are cut so low as to leave little if any margin. Makers prefer the smaller contracts which are secured at a better price. Hoops are in good demand, mostly on overseas account.

SHEFFIELD.

(From our own Correspondent.)

Quieter Steel Conditions.

A REVIEW of the position of the various branches of the Sheffield steel trade shows that the situation at present is hardly as good as it has been in recent weeks. What one has previously reported as to the briskness of trade in special departments, such as those producing cold rolled material, motor car and stainless steels, still holds good. So do previous reports as to the quietude in acid steel, the production of which shows no increase. The principal change to report is in the basic steel department, which has been busy for a considerable time, but which now shows some falling off. At the local works of the United Steel Companies, only ten furnaces out of a total of thirty are at present in operation, and this proportion is probably typical of the open-hearth steel industry in the Sheffield district generally. The present state of things is not peculiar to Sheffield, but applies to other great industrial centres of the country. It is thought to be partly due to the disturbance caused by the General Election, and hopes of an immediate recovery are entertained. At the same time, increased prices of British steel are interfering with business, and there is a revival of continental competition in some lines.

Figures of Production.

The latest figures of steel production, relating to April, show that this district did not maintain its position. The total output was 96,600 tons, as compared with 110,200 tons in March and 90,400 tons in April last year. The decline was most notable in regard to acid steel, the quantity of which was only half that of basic material. In Lincolnshire, on the other hand, there was an improvement, no doubt owing to the reopening of the Redbourne Hill works. The quantity of steel produced, which was practically all basic, was 65,000 tons, as against 61,000 tons in the previous month and 45,100 tons twelve months ago. The Lincolnshire output of pig iron in April was 63,900 tons—of which 60,600 tons was basic—which was the same figure as that of March, but 5000 tons more than April of last year.

A Busy Firm.

The only large works in this district which are on full time, or practically so, are those of the Park Gate Iron and Steel Company, Ltd., to whose successful operations during the past year I have previously referred. Some interesting information, supplementing that of the annual report, was given by the chairman at the shareholders' meeting last week. He said that the firm's output of steel during the year ending March 31st was the record one of 179,066 tons, or 6785 tons more than in the previous year. It was a curious fact that, whilst other firms had been complaining of want of orders, the Park Gate Company had been in the peculiar position of having a record output. The mills had been practically working full time throughout the year. With regard to the derating scheme, which comes into operation in October next, he mentioned that they would get an advantage equal to about 2s. 6d. per ton on their output. As against the higher costs of fuel and scrap, they had achieved various economies, among which were the very satisfactory results from the gas machines installed for the heating of the open-hearth furnaces. He added that the board had been very carefully considering what ought to be done to improve the position at Park Gate. The works had been fairly well employed, and yet the margin between the selling price and the cost of production remained so small that profits were not what they ought to be for the work done. They had therefore come to the conclusion to spend a considerable sum on the plant in order to secure further economies. They would not undertake this expenditure without making quite sure of benefit.

Low Temperature Progress.

A very promising state of things is reported in connection with the low-temperature carbonisation of coal at Askern Colliery, near Doncaster. A new smokeless fuel plant is to be lighted, and in about three weeks, when the heating of the retorts is complete, half the plant will be put into full operation, and will be worked night and day for seven days a week. This portion will deal with 2100 tons of coal per week, and ultimately twice that quantity will be handled. The weekly output from the first section will be 1500 tons of smokeless fuel, 45,000 gallons of coal oil, 5000 gallons of crude motor spirit, and 12 tons of sulphate of ammonia. The entire output of the fuel until next winter has already been sold. A special feature of the plant is the use of the first electro-static condenser in this country for separating gas from tar oil. Another is a large rotary drier, for wet coal and slack from the washers, which will utilise waste heat from the retorts. The smallest grades of coal will be used, from ⅛in. downwards.

Sewage Works Extension.

The bio-aeration system for the treatment of sewage at the Sheffield Corporation works, which was originated by Mr. J. Haworth, the general manager, and has since been adopted in various large towns of this and foreign countries, is being extended. The system was commenced in Sheffield in 1921. Seventeen units are now nearing completion, and four additional units of plant, with 12 acres of drying beds, have just been started, at an estimated cost of £134,000. Members of the Yorkshire Association of the Institution of Civil Engineers, who visited the works last week, were informed that the working and capital charges amounted to £67,964 per annum, equivalent to a rate of nearly 7d. in the pound, which was the lowest sewage rate of any large borough in the West Riding, and probably in England.

Coke Oven Results.

Some interesting figures have been published with regard to the working of the new coke oven plant of the Nunnery Colliery Company, at Handsworth, Sheffield, which was visited by a party of coke oven managers from all parts of the country last week. The plant is of the Becker type, and is the first of its kind to be installed in the country. The ovens are of the regenerative type, and have a carbonising time of 12 hours 50 min., as compared with the 32 hours of the old waste-heat ovens. The capacity per oven is 12·2 tons, as against 7 tons; capacity per twenty-four hours, 22·7 tons, as against 5·2 tons; and they produce 7000 cubic feet of surplus gas per ton of dry coal, whereas the others yielded none. The plant is now producing each week 2800 tons of coke, 50 tons of sulphate of ammonia, 36,000 gallons of tar, 14,000 gallons of crude benzol; and is delivering about 27,000,000 cubic feet of debenzolised gas with a calorific value of 550 B.Th.U. per cubic foot to the Sheffield Gas Company for lighting and power purposes. The yields per ton of dry coal are high:—Gas, 11,210 cubic feet, with a calorific value of 553 B.Th.U.; tar, 10·21 gallons; ammonium sulphate, 31·53 lb.; benzol, 3·54 gallons; coke, 15·38 cwt. The percentage of total gas made available for sale is 62·6.

Goole Dock Developments.

The question of the extension and improvement of Goole docks, to which I referred a few weeks ago, has been carried another step forward. At a meeting of the Council of the Goole Chamber of Commerce and Shipping this week a letter was read from Sir John Eglesome, the managing director of the Aire and Calder Navigation, stating that the company was still in correspondence with the London, Midland and Scottish Railway Company in regard to the development of the north side of the new West Dock by means of sheds, sidings and cranes. The lay-out and general plans had been agreed to by the engineers of the two companies, and he was now inquiring from the railway authorities as to what active steps they were taking to make a beginning with the work. There was also a letter from the London, Midland and Scottish Railway Company stating that a scheme had been formulated for the development of the north side of the West Dock by the provision of a shed, together with the requisite cranage and siding accommodation. Such a scheme involved the spending of a large sum of money, but the matter was prominently under notice, with the object of placing the facts before the directors of the railway company.

Lighter Trades.

A steady business is maintained in hand and engineers' tools, but there is no expansion, and dealers are inclined to keep stocks down to the minimum. Farm and garden tools are enjoying a fair demand, as also are twist drills, but the file factories continue quiet. The demand for mining and quarry tools and equipment is only moderate, but an increasing request for road-making tools is reported. There has been an increasing sale of American engineers' small tools and files in this country for several years, but German imports show a tendency to decline. There has been no spring revival in the cutlery and plate trades, and the volume of business is stated to be below last year's level. Very few firms are at all busily employed, and there is a good deal of price cutting in order to secure trade.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Exports.

THE healthy state of the Cleveland iron and steel trade is reflected in the export returns for the past month. In April the tonnage of iron and steel shipped from the river Tees was 96,912 tons. This constituted a record for three years past, but the May figure falls short of that total by only 670 tons, and actually the pig iron shipments, which reached 32,718 tons, are the heaviest of any month since March, 1926. It is a fortunate circumstance that the shortage of pig iron is not being permitted seriously to cripple the export trade, as traders have been struggling for years past to pick up lost threads, and there are indications at the moment that the possibilities of overseas trade are expanding. France, Belgium and Germany—our most formidable competitors—all have been buying Cleveland iron in increased quantities; so, too, has Italy, whilst a shipment of 1350 tons across the Atlantic is chiefly important as an indication of possibilities in that direction. The manufactured iron and steel shipments from the Tees in May reached 63,524 tons, compared with 66,811 tons in April, the fall in the exports to India and Ceylon from 15,303 tons to 7322 tons more than accounting for the whole of the decline.

Imports Dwindling.

Less and less foreign iron and steel is being imported. Statistics presented at this week's meeting of the Tees Conservancy Commission showed that during May the imports totalled only 10,686 tons, as compared with 16,780 tons in April and 21,207 tons in May last year. During the seven months ending May 31st, the imports amounted to 102,939 tons, as against 134,145 tons in the corresponding period of 1927–28 and 42,718 tons in the pre-war period of 1913–14. Crude sheet bars, billets, blooms, &c., unloaded in the port during the seven months totalled 55,818 tons; pig iron, 18,296; and plates, bars, angles, rails, sheets, joists, &c., 28,825 tons, as against respectively 102,967 tons, 4408 tons, and 26,770 tons in the corresponding seven months of 1927–28.

Cleveland Iron Trade.

The feeling of optimism has not deserted commercial circles in the North of England, and notwithstanding the political disturbance there is a steady flow of business in iron and steel, and prices reveal a rising tendency. Trade development is expected to continue along steady lines. Home consumers are known to have nothing like fully covered their requirements, and they are expected to distribute further substantial orders in the near future; while buyers abroad have been attracted to this market of late. Prospective further enlargement of pig iron production falls far short of needs. The two additional blast-furnaces to be put into operation shortly—one on Cleveland iron and the other on hematite iron—at the Jarrow Works of Palmers Shipbuilding and Iron Company, Ltd., will do little to relieve the existing stringent situation, as the make of these furnaces is already disposed of. Ironmasters continue to hold off the market, having disposed of their output to the end of September, and refuse to quote for delivery further ahead; while second-hand holders have only limited quantities to offer, and stocks have been cleared. Prices are not quotably altered, but an upward movement would create no surprise. No. 1 Cleveland foundry iron is 72s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d.

Hematite Pig Iron.

Supply of East Coast hematite pig iron is inadequate, but the shortage is much less acute than in the case of Cleveland iron, and prices keep comparatively low, ordinary qualities of hematite being still obtainable at 74s., or only 4s. above the price of No. 3 Cleveland. In normal pre-war times mixed numbers of hematite realised 8s. to 10s. above the ruling quotation for Cleveland iron. Makers of hematite are fully sold to the end of June, and have no stocks to fall back upon, but merchants are fairly well bought. The latter, however, quite expect quotations to advance, and are therefore in no hurry to unload their holdings.

Ironmaking Materials.

Business in foreign ore is very quiet. Merchants are well sold and are not anxious to make further extensive contracts, as they fear shortage of supply and look for a rise in values. Nominally, market rates are based on 23s. c.i.f. Tees for best Rubio ore, but it is doubtful whether business of moment could now be made on that basis. There seems little likelihood of coke becoming at all plentiful. Prices show further upward tendency, and buyers are rather anxious to arrange forward contracts at current rates. Good average blast-furnace qualities are fully 19s. delivered to works in this area.

Manufactured Iron and Steel.

Satisfactory accounts continue to be given of the manufactured iron and steel trade. Most firms have good order books, and a considerable amount of new business is coming forward. Semi-finished steel producers are busy and hope to continue so; and finished steelmakers have a lot of work in hand. No price changes are recorded.

The Coal Trade.

There is not the slightest uneasiness as to the trend of the Northern coal trade position for June deliveries, as fitters for every grade report being amply sold, and have sufficient urgent business on hand to absorb any increased outputs that can be arranged. Buyers are inquiring freely and find that they are practically limited to contractors to secure any further supplies. It is not merely a demand for a few classes of coal, but for all descriptions—which is unusual at this time of the year. It is customary to find an easiness in the gas position, for example, but this is not the experience at present, as gas fuel is among the strongest features. It has been steadily gaining in firmness, and best grades are now fully 16s. 6d. to 17s.; specials, 17s. 6d.; and other classes, 16s. to 16s. 6d. It may be that prices are now quite high enough all round in respect of securing more business. Indeed, merchants assert that it is difficult to procure fresh orders at current figures. Much of the coal now being shipped is on old contracts, in which some merchants are reputed to have lost heavily. Thus, good as trade is at the moment, there may come a halt in buying, although, as indicated, the June position is fully assured. Buyers of best Northumberland steams are also finding difficulty in securing prompt lots for this month. All prices for large are very firm. Steam smalls are a brisk trade at late figures. The coke market is firm and more cheerful reports are coming to hand from Scandinavia. The feared competition from German producers does not appear likely to develop, and exporters are confident that they can secure renewals of all existing contracts when expiration dates approach. At the same time they hope to secure a share of the expanding demands from various continental countries. Gas coke is in limited supply at 21s., patent cokes are firm at 18s. 6d. to 19s., and beehive or other special makes 26s. to 28s.

Coal Trade Wages.

The healthy tone of the Durham coal industry is reflected in the wages ascertainment issued this week. This shows that but for the operation of the minimum wages clause the economic minimum in April, by which wages in June would be governed, would have been 41·05 per cent. In the month of March, the ascertainment was 36·37 per cent., which shows an increase of 4·68 per cent. for the period under review. The Durham County minimum is 65 per cent. on basis wages, and therefore the minimum applies. This means that the colliery owners have to make up a deficiency of 23·95 per cent. in June as against 28·63 per cent. for May. The better state of the Northumberland coal trade is not yet shown in the monthly ascertainment. The result of the proceeds and costs in April which would determine wages in June would have given an economic wage of 26·93 per cent., as against 29·65 per cent. in May, a falling off of 2·72 per cent. The minimum percentage addition to basis under the county agreement is 40, and therefore the deficiency to be made up by the owners is 13·07 per cent.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

DURING the month of May twenty-four vessels, of 44,791 tons aggregate, were launched from Clyde yards, bringing the totals for this year to date up to eighty-eight vessels of 236,825 tons aggregate, compared with eighty-seven vessels of 240,732 tons in the same period last year. The largest vessel launched last month was the "Rangitani," a twin-screw motor, 17,500 tons, built for the New Zealand Shipping Company, Ltd., London. The list also included the following vessels:—The "Markhor," a turbine-driven cargo steamer of 7900 tons, for T. and J. Brocklebank, Ltd., Liverpool; the "Gregalia," a cargo vessel of 7100 tons, for the Donaldson Line, Glasgow; the "Lylepark," cargo steamer of 5200 tons, for the Denholm Line Steamers, Ltd., Glasgow; and the "Berwindlea," a steam collier, for the Berwindmore Steamship Company, Ltd., Liverpool. This ship has the distinction of being the first steamer to be originally designed for burning pulverised fuel. Nothing definite with regard to new contracts was announced during last month, but it is said that several orders have been practically settled. The outlook is considered somewhat uncertain however. Higher costs of production, owing to increased prices of steel and the possibility of increased costs of labour, are factors against the expansion of orders, as owners are unlikely to view with equanimity the higher prices involved. Consequently, with the shipbuilding industry under the burden of higher costs, the number of unoccupied berths will probably increase.

Steel.

There has been little change in the steel trade. The higher prices have not had any apparent effect so far, demands being neither better nor worse since the increase. Specifications for plates are especially disappointing, and though sections are perhaps a little better off, the latter are not by any means busy. Light steel sheets have a moderate turnover, though not up to expectations, but heavy descriptions have a rather poor market. Tube makers, on the other hand, are comparatively busy in all branches.

Iron.

The position in the bar iron trade is not improving, and producers have difficulty in maintaining even a moderate degree of employment. Despite higher costs and increased prices in other districts, the local quotations for home and export are unchanged at £10 5s.—fixed—and £9 15s. per ton respectively. The re-rolled steel department is not much better off, but costs maintain prices at £8 home and £7 15s. per ton export.

Pig Iron.

The recent slight improvement in the demand for hematite has hardly been maintained, while foundry qualities are still as plentiful as ever, despite restricted outputs. Minimum prices are unchanged.

Coal.

In most districts round coals are fairly plentiful. In Lanarkshire the decline in home demands is most severely felt, and a considerable amount of idle time is reported. Lothians steams are just steady, but some improvement is noticeable in Fifeshire descriptions, which are now firmly held at full recent quotations. Washed materials are still the strongest feature of the market, especially treble and double nuts. Aggregate shipments amounted to 247,148 tons, against 246,007 tons in the preceding week and 236,660 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE conditions in the steam coal trade continue on the quiet side, and there is still a good deal of irregularity in market values, but at the same time the market is really steadier than was thought at one time would be the case. The whole position is governed by tonnage, and at the end of last week the state of the docks showed that there were twenty-six idle tipping appliances and only four steamers were waiting to berth. Arrivals over the week-end were disappointing, inasmuch as on Monday the number of idle tipping appliances was eighteen, with five steamers waiting, but on Tuesday the position was slightly better, as while the number of idle appliances was nineteen, there were twelve vessels waiting to load. The situation may even improve to some extent, as although the chartering of tonnage this week has been on only moderate lines, it was better last week, and on one day alone tonnage was taken up to load over 100,000 tons. There are quite a number of orders still in hand, but new business for prompt loading cannot be described as active. Contract operations display no particular feature, though the report is current that the Buenos Aires electricity works is understood to be in the market for 200,000 tons of sized coals for delivery over the remainder of the year. The Greek Government is also inquiring for two cargoes of leading Admiralty coals for fairly early shipment. Outside these, however, there is no outstanding demand, though there is a fair inquiry for coals for foreign coaling depôts.

Coal Trade Audit.

According to the secretary of the South Wales Coalowners' Association, the improvement in the trading position shown by the audit for the three months ended January last was maintained during the three months ended April. For the latter period the report of the joint accountants certifies that the general percentage payable under the agreement for the three months commencing June 1st is 10·41 per cent. on the 1915 standard rates. This compares with a general percentage under the last audit of 2·10 per cent. above the standard rates and with 8·4 per cent. below those rates in the corresponding period of last year. The principal factors which have contributed to this improvement are that trading results of the industry have shown an increase of 4¼d. per ton in the average realised pithead price, while the costs of production have been reduced by about 3¼d. per ton. The credit balance during the three months averaged 2·24d. per ton and amounted to £99,063, which compares with a loss of 5·54d. per ton, representing a deficit of £222,149 in the previous three months, and a loss of 1s. 3·99d. per ton, equal to £693,438, in the corresponding period of last year. The credit balance in the April quarter of the present year compares, however, with an aggregate trading loss under the present agreement of £4,685,000. This is the first time since May, 1924, that there has been a trading profit certified, and it should be pointed out that the industry got the benefit over the whole of the period of the last audit of the rebate in railway rates granted as from December 1st, 1928.

Miners' New Agreement.

When the Executive Council of the South Wales Miners' Federation met at Cardiff on Monday, the secretary announced that a request had been received from the coalowners that a meeting of the Conciliation Board should be held with a view of ascertaining whether it was possible to commence negotiations for the consideration of a new agreement after the expiration of the present agreement at the end of the year. The Council decided to accept the invitation, with the provision that the meeting should be confined to the consideration of what suggestions should take place regarding the negotiations. The decision is, therefore, of a non-committal character, except that it shows that the Council is disposed to begin a preliminary discussion.

Trade at the Ports.

According to the returns of the Great Western Railway Company for the five ports in this district under its control, the traffic for the four weeks ended May 12th last came to 3,084,053 tons, compared with 2,781,310 tons. Taking the whole of this year from January 1st to May 12th, imports and exports aggregated 13,943,445 tons, which figure compares with 12,813,555 tons for the same period of 1928, and with 14,541,215 tons for the same period of 1927.

Boilermakers' Agreement.

The South Wales Dry Dock Owners and Ship Repairers' Federation has given the Boilermakers' Society three months to terminate the existing agreement, which came into operation on March 1st, 1928, after negotiations which extended over nearly two years. This agreement so far as the boilermakers were concerned did not alter the base rates, but provided important changes in the working conditions and overtime rates, which the employers hoped would enable them to compete successfully with the North Country and continental yards. The agreement does not terminate until the end of August, so that there is reasonable time for the parties to thrash out a new one.

Current Business.

The tone of the steam coal market is quiet in most branches, but the collieries producing the superior grades are in a fairly comfortable position. The lower grades of large coal do not find such a ready outlet, and as a consequence there is irregularity in the prices quoted, with most of them on the new minimum prices. Small coals and sized qualities are, however, in demand, and none too readily available. The coke and patent fuel sections display no feature, but are steady, but pitwood is quiet at round about 25s. 6d.

LAUNCHES AND TRIAL TRIPS.

BROOKWOOD, steamer; built by Wm. Gray and Co., Ltd., to the order of Messrs. R. A. and W. W. Constantine, Middlesbrough; dimensions, 421ft. 4in. by 53ft. 6in. by 28ft. 11in.; to carry cargo. Engines, triple-expansion, 24½in., 41in., 68in. by 45in. stroke, pressure 200 lb. per square inch; constructed by the builders; trial trip, May 18th.

VILLANGER, single-screw motor vessel; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of Messrs. Westfal-Larsen and Co., A/S Bergen; dimensions, 415ft. by 54ft. 10in. by 28ft. 9in.; to carry 8500 tons. Engines, Diesel engines of the Burmeister and Wain-Harland and Wolff type; constructed by Messrs. J. G. Kincaid and Co., Greenock; launch, May 22nd.

BERWINDLEA, single-screw collier; built by Blythswood Shipbuilding Company, Ltd., to the order of Berwindmoor Steamship Company, Ltd.; dimensions, 400ft. by 52ft. by 31ft.; to carry coal and ore. Engines, triple-expansion; constructed by Messrs. D. Rowan and Co.; launch, May 23rd.

FAIRRIVER, steamship; built by Barclay, Curle and Co., Ltd., to the order of Fairport Steamship Company, Ltd.; dimensions, 259ft. by 43ft. 4in. by 20ft.; to carry cargo. Engines, triple-expansion, pressure 180 lb. per square inch; constructed by the builders; trial trip, May 27th.

HAXBY, steamship; built by Wm. Gray and Co., Ltd., to the order of Sir R. Ropner and Co., Ltd.; dimensions, 434ft. 4in. by 54ft. 3in. by 30ft. 1in.; to carry cargo. Engines, triple-expansion, 26½in., 44in. and 73in. by 48 in., pressure 180 lb. per square inch; constructed by the builders; trial trip, May 29th.

KOSMOS, whaling factory; built by Workman, Clark (1928), Ltd., to the order of the Kosmos Whaling Company; dimensions, 550ft. by 77ft. by 50ft. 6in.; to be used as a whale oil factory ship and oil tanker. Engines, quadruple-expansion; pressure 250 lb. per square inch; constructed by the builders; launch, May 30th.

FARRANDOC, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steamships, Ltd., Fort William, Ontario, Canada; dimensions, 260ft. by 43ft. 4in. by 20ft.; to carry 2600 tons. Engines, triple-expansion; pressure 180 lb. per square inch; constructed by the builders; trial trip, June 1st.

CONTRACTS.

THE B.E.N. PATENTS, Ltd., 92, Tottenham Court-road, London, W. 1, have received an order for B.E.N.-Myers high-pressure washers from the L.M.S. railway.

THOS. W. WARD, Ltd., Sheffield, the sole distributors for the Ketton Portland cement, have received an order for a considerable quantity of "Ketco" Portland cement for use on the new Liverpool-East Lancashire arterial road to Manchester.

THE ENGLISH ELECTRIC COMPANY has received an order from the Darlington Corporation Tramways for six complete four-wheel single-deck railless omnibuses. Each omnibus will have seating accommodation for thirty-two passengers. The equipment will consist of a single 60 horse-power motor and standard foot-operated controller, and rheostatic braking will be provided.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MARSHALL, SONS AND CO., Ltd., of Gainsborough, ask us to announce that they have opened an office at 14, New-street, Birmingham, the representative there being Mr. A. Powell.

SPENCER-HOPWOOD, Ltd., have removed their London office from 74, Chandos House, Palmer-street, Westminster, S.W. 1, to 17, Dartmouth-street, Westminster, S.W. 1. Their telephone number remains the same, *i.e.*, Victoria 1575.

MR. FRED J. HENSON, manager of the technical and research bureau of the Red Triangle Cement Organisation, has been appointed a director of the Portland Cement Selling and Distributing Company, Ltd., 20, Buckingham-gate, S.W. 1.

THE MOSS GEAR COMPANY, Ltd., Birmingham, informs us that it has built and equipped a large modern factory at Chester-road, Tyburn, Birmingham, for the manufacture of all kinds of machine-cut gearing. The firm's postal address now is Crown Works, Tyburn, Birmingham.

CATALOGUES.

CROFTS (ENGINEERS), Ltd., Thornbury, Bradford.—A folder on standardised silent spur gear drives.

PHILIPS LAMPS, Ltd., 145, Charing Cross-road, W.C. 2.—Price List No. 404 of industrial lighting fittings.

ANGELO BROTHERS (ENGLAND), Ltd., 45, St. Mary Axe, E.C. 3.—Two booklets dealing with shellac, its manufacture, properties, and uses.

UNIVERSAL SYSTEM OF MACHINE MOULDING AND MACHINERY, Ltd., 13/15, Wilson-street, E.C. 2.—Latest catalogue of sand preparation machinery.

AUTOMATIC TELEPHONE MANUFACTURING COMPANY, Ltd., Strowger Works, Liverpool.—Particulars of the A.T.M. Doignon Baudot multiplex apparatus.

F. PRATT AND CO., Ltd., Victoria-street East, Halifax.—1929 catalogue containing particulars of a complete range of sizes in all the leading types of lathe chucks.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 21/-
(1) Spanish	22/-
(1) N. African	22/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 18 0	—
No. 1 Foundry	3 15 0	—
No. 3 Foundry	3 12 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 14 0	3 14 0
No. 1	3 14 6	3 14 6
Cleveland—		
No. 1	3 12 6	3 12 6
Silicious Iron	3 12 6	3 12 6
No. 3 G.M.B.	3 10 0	3 10 0
No. 4 Foundry	3 9 0	3 9 0
No. 4 Forge	3 8 6	3 8 6
Mottled	3 8 0	3 8 0
White	3 8 0	3 8 0
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 11 0	—
„ „ Foundry	3 13 6	—
(3) Northampton—		
Foundry No. 3	3 10 0	—
Forge	3 6 0	—
(1) Derbyshire—		
No. 3 Foundry	3 13 6	—
Forge	3 9 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 4 6 (*a*); 4 7 6 (*b*); 4 11 0 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 10 0	—
Second Quality Bars	10 0 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 12 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	9 0 0 to 9 2 6	—
Gas Tube Strip	10 17 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 12 6	7 12 6
Sections	8 2 6	7 2 6
Steel Sheets, ¼in.	9 0 0	8 12 6
Sheets (Gal. Cor. 24 B.G.)	13 10 0	13 12 6 to 13 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 12 6	—
Angles	8 2 6	—
Boiler Plates	12 15 0	—
Joists	8 2 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 2 6	—
„ (Small Round)	8 10 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 12 6 to 9 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	7 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	8 10 0	—
MIDLANDS—		
Small Rolled Bars	8 5 0 to 8 15 0	—
Billets and Sheet Bars	6 7 6 to 6 12 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 12 6 to 13 15 0	—
Angles	8 2 6	—
Joists	8 2 6	—
Tees	9 2 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 15 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/3 to 18/9
Block Tin (cash)	198 15 0
„ „ (three months)	201 10 0
Copper (cash)	73 17 6
„ (three months)	73 12 6
Spanish Lead (cash)	23 12 6
„ „ (three months)	23 12 6
Spelter (cash)	26 10 0
„ (three months)	26 7 6
MANCHESTER—	
Copper, Best Selected Ingots	77 10 0
„ Electrolytic	85 0 0
„ Strong Sheets	112 0 0
„ Tubes (Basis Price), lb.	0 1 3½
Brass Tubes (Basis Price), lb.	0 1 1½
„ Condenser, lb.	0 1 3½
Lead, English	25 5 0
„ Foreign	23 15 0
Spelter	26 12 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/11 per lb.	
Ferro Tungsten	2/9 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 0 0	7/6
„ „ 6 p.c. to 8 p.c.	£24 0 0	7/-
„ „ 8 p.c. to 10 p.c.	£23 10 0	6/-
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£36 0 0	12/-
„ „ „ 1 p.c. carbon	£38 0 0	15/-
„ „ „ 0·70 p.c. carbon	£42 0 0	17/-
„ „ „ carbon free	1/2 per lb.	
Metallic Chromium	2/6 per lb.	
FerroManganese (per ton)	£13 15 0 for home; £13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
„ „ 75 p.c.	£19 10 0 scale 6/- per unit	
„ Vanadium	13/- per lb.	
„ Molybdenum	4/- per lb.	
„ Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/4 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
LANARKSHIRE	
(f.o.b. Glasgow)—Steam	13/6
„ „ Ell	14/-
„ „ Splint	15/6 to 16/-
„ „ Trebles	14/3
„ „ Doubles	13/6
„ „ Singles	12/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
„ „ Jewel	17/6
„ „ Trebles	13/9
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	13/9 to 14/-
Screened Navigation	17/6
Trebles	14/6
Doubles	13/9
Singles	12/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/-
Secondary Steam	12/6
Trebles	14/6
Doubles	13/6
Singles	12/-

ENGLAND.

	Inland.	Export.
(3) N.W. COAST—		
Steams		24/- to 25/-
Household		38/- to 51/-
Coke		23/- to 23/6
NORTHUMBERLAND—		
Best Steams		14/9 to 15/-
Second Steams		13/6 to 13/9
Steam Smalls		9/6 to 10/6
Unscreened		13/- to 13/3
Household		21/- to 26/-
DURHAM—		
Best Gas		15/9 to 16/-
Second		15/6 to 15/9
Household		21/- to 27/-
Foundry Coke		22/- to 28/-
SHEFFIELD—		
Best Hand-picked Branch	27/- to 28/6	—
Derbyshire Best Bright House	20/- to 23/-	—
Best House Coal	19/6 to 20/6	—
Screened House Coal	17/6 to 18/6	—
„ „ Nuts	16/- to 17/6	—
Yorkshire Hards	15/6 to 16/6	—
Derbyshire Hards	15/6 to 16/6	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	6/- to 7/-	—
Smalls	2/- to 4/-	—
Blast-furnace Coke (Inland)	14/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		20/- to 21/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/9 to 20/-
Second Smokeless Large	19/6 to 19/9
Best Dry Large	19/- to 19/6
Ordinary Dry Large	18/- to 18/6
Best Black Vein Large	18/6 to 19/-
Western Valley Large	18/3 to 18/6
Best Eastern Valley Large	18/- to 18/3
Ordinary Eastern Valley Large	17/3 to 17/9
Best Steam Smalls	13/3 to 13/9
Ordinary Smalls	12/6 to 13/-
Washed Nuts	20/- to 22/6
No. 3 Rhondda Large	20/6 to 21/-
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/3 to 17/9
„ „ Through	16/- to 17/-
„ „ Smalls	13/6 to 14/-
Foundry Coke (Export)	26/6 to 36/-
Furnace Coke (Export)	21/- to 23/-
Patent Fuel	20/- to 21/6
Pitwood (ex ship)	25/3 to 25/9
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	33/- to 36/6
Seconds	27/6 to 30/-
Red Vein	23/- to 27/-
Machine-made Cobbles	40/- to 44/-
Nuts	40/- to 44/-
Beans	23/6 to 25/6
Peas	17/9 to 18/6
Breaker Duff	9/- to 9/6
Rubbly Culm	9/9 to 10/3
Steam Coals :	
Large	18/- to 19/-
Seconds	17/- to 18/-
Smalls	10/6 to 13/-
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated. coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Industrial Outlook.

THE situation of the iron, steel and engineering trades continues satisfactory, with sufficient employment in nearly all departments, and the outlook would be particularly encouraging if certain factors did not appear likely to modify trade conditions in the future. In the first place, there is some uncertainty as to what will happen to the Steel Cartel. The forthcoming meeting to decide upon the renewal of the Union will be held in Paris, and not in Vienna, as previously arranged, and although Germany has not officially notified her intention of withdrawing from the Cartel, it is understood that the fate of that body will depend upon what can be done to meet the claims of Germany and Belgium. There must be some redistribution of quotas and an arrangement for organising sales in foreign markets. Another matter that affects the situation is the considerable quantity of material being supplied by Germany on account of reparations. This material has enabled France to carry out important works at home and in the Colonies, which all aim at developing the national economic resources, particularly railways, harbours, inland waterways and hydro-electrical plants, and even the provision of machinery for new industries, but, at the same time, constructive engineers complain that they are feeling the effects of the competition of reparation material. Manufacturers will be glad to see the end of the Dawes arrangement, but if it is not adequately replaced by payments which will permit of the vast programme of public works being carried out, the situation will be less satisfactory. Still another factor is the increasingly heavy financial burdens on industry, which have now reached a point where it is feared that an inevitable raising of prices will check buying. The Government is so far alive to the danger of an inflation of prices that it has postponed, until the beginning of next year, the application of the new social legislation which was to have provided the means of carrying out a more elaborate pensions scheme. Every effort is now being made to avoid the imposition of further burdens on industry. Prices of coal, coke and pig iron have been increased, but steel producers have made no change in their quotations. If the engineering industries are assured that no further charges will be imposed upon them it is believed that the work of developing the Colonies will alone provide them with fair employment for some years to come; but in view of the increased productive capacity the time will certainly arrive when all industries will have to depend more largely upon foreign markets. Meanwhile, the reports of electrical and other engineering companies show generally improved financial results during the past year.

Port of Bordeaux.

The reconstruction of the wharves at Bordeaux has long been regarded as necessary and urgent, but it is only recently that it has been possible to do anything, and orders have now been given out for work that will probably take three or four years to complete. The present old wharves were built in 1850 on timber piles which did not reach the hard foundation, this being at a depth of 69ft., and there has consequantly been a sinking of the piers, while the stone blocks at the base prevent ships of average draught from drawing up alongside. It has, therefore, been decided to construct reinforced concrete piers down to the solid foundation, from 46ft. to 95ft. beyond the existing piers. This plan will increase considerably the area of the wharves on which concrete warehouses will be built amply sufficient for all possible needs, and there will be a complete equipment of elevating machinery. The new wharves will have a length of 1060 yards, and, with those extending beyond the town, there will be a total length of 3260 yards in deep water.

The Air Force.

When the Air Ministry was created some months ago considerable trouble was experienced in determining its functions, for the new Minister, Monsieur Laurent Eynac, would have nothing but absolute control over the military and naval air forces, and the other Ministers were equally firm in opposing any diminution of their authority. Apparently the differences between them have been adjusted, for the Air Minister has introduced a Bill into the Chamber of Deputies which places upon him entire responsibility for the technical progress and the manufacture of aeroplanes as well as for the training of pilots. He will supply to the war and naval departments the men and machines necessary for active service and for the reserves, and he will create five zones for air defence operations, four in France and one in North Africa, each under the command of an officer appointed by the Air Minister. This arrangement gives to the Air Minister complete control over the organisation of the air service, to the exclusion of its strategical utilisation, which remains with the Ministers of War and Marine.

Foreign Trade.

About two-thirds of the values of imports into France are of "material necessary for industry," and three-fourths of the exports are of manufactured goods, and until about a year ago the value of goods sent abroad exceeded that of the material and produce brought into the country. That was a time of depreciated currency when manufacturers were able to sell cheaply in foreign markets. Now that production costs have advanced business with those markets is declining, and the monthly trade returns, although causing some uneasiness by revealing an adverse balance of trade, are really satisfactory because they reflect the general industrial activity at home. The total value of imports during the first four months of the year was 20,413 million francs, an increase of 2859 million francs, as compared with the similar period of 1928. The exports were valued at 16,419 million francs, a decline of 627 million francs. There was a notable advance in the imports of manufactured goods as well as of raw material, and the exports of manufactured goods declined, although the total for the four months amounted to 10,175 million francs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

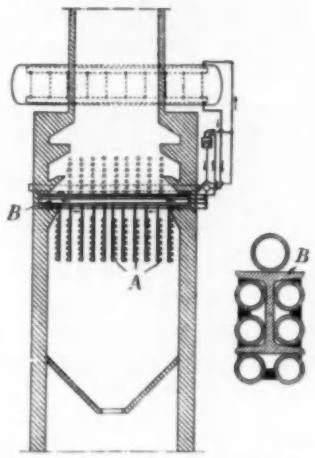
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

310,695. June 6th, 1928.—SUPPORTS FOR WATER TUBES, *The Superheater Company, Ltd.*, 195, *Strand, London, W.C.* 2.

The inventors propose to support the generator or superheater tubes A of a boiler from transverse beams B arranged within

Nº310,695



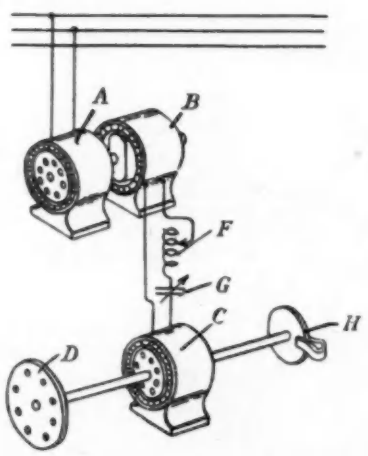
the setting. These beams—see detail sketch—are of normal rolled sections and are water cooled by means of tubes welded to them. It is also suggested that the beams may be of such a section that they contain the water-cooling passages.—*May 2nd*, 1929.

DYNAMOS AND MOTORS.

308,674. August 13th, 1928.—SPEED CONTROL SYSTEMS FOR ELECTRIC MOTORS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.

This specification describes a method of maintaining the speed of an asynchronous motor constant when operated from a source of variable frequency. In the drawing, a motor generator set is shown consisting of an ordinary induction motor A, and a synchronous generator B. The latter supplies a motor C, which drives a television apparatus D. The generator has a

Nº308,674



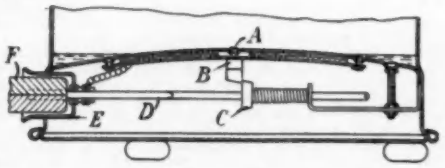
permanent magnetic field, and produces a voltage which varies with its frequency. In circuit with the motor is an inductance F and a condenser G. The circuit thus formed is tuned to resonance at the lowest frequency of the circuit, which modifies the voltage supplied to the motor in response to changes in the frequency of the source. The voltage impressed upon the motor C varies inversely with the frequency, and by properly adjusting the load at H, the increase in slip with a decrease in voltage may be made such that the actual speed remains constant as the frequency increases.—*May 2nd*, 1929.

SWITCHGEAR.

310,581. February 8th, 1928.—THERMAL ELECTRIC SWITCHES, Norman Dennes, of Whitecroft, Solihull, near Birmingham, and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.

The thermal switch described in this specification is par-

Nº310,581



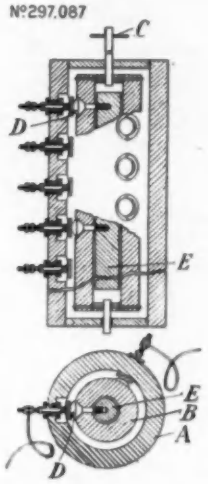
ticularly suitable for disconnecting the supply of current when a vessel containing water that is electrically heated runs dry. If the level of the liquid falls so that the centre of the bottom of the vessel is no longer covered, this becomes hot and expands. Since the bottom of the vessel is held around the circumference, the centre moves upwards, carrying the stud A and nut B with it. The abutment C is thereupon released and the plunger D is shot by the spiral spring in the direction of the housing E, thereby pushing the socket F from the housing and interrupting the heating circuit.—*May 2nd*, 1929.

TRANSFORMERS AND CONVERTERS.

297,087. September 12th, 1928.—ELECTRIC TRANSFORMERS, *International General Electric Company, Inc., of* 120, *Broadway, New York.*

A transformer tap-changing switch constructed in accordance with this invention consists of two tubes A and B, composed of insulating material. The tube B, which can be turned by a handle C, carries a number of contacts D, which are in connection with each other, as they are attached to the metal piece E. The fixed tube carries spring-mounted contacts, as shown. On

Nº297,087



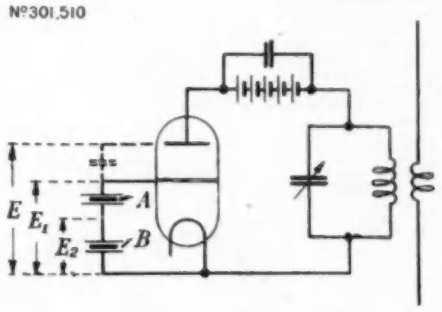
the outer tube the contacts lie in two parallel rows, and are so distributed that some of the tapping points to be combined to a neutral point lie on one row and some on the other row. Tapping points belonging to one phase are distributed in order over the two rows. The requisite distance between the contacts is attained without employing a long tube, and the contacts can be crowded together on a small part of the circumference, so that the switch can fit in the space between the two-core windings in the transformer casing.—*May 2nd*, 1929.

TELEGRAPHS AND TELEPHONES.

301,510. November 30th, 1928.—PIEZO-ELECTRIC CONTROL OF VALVE OSCILLATION GENERATORS, C. Lorenz Aktiengesellschaft, of 1, Lorenzweg, Berlin-Tempelhof, Germany.

On account of the small loading properties of piezo crystals and particularly with reference to the potentials to be applied to their electrodes, the direct control of oscillating valves with more than 5 to 10 watts output in the case of quartz-controlled transmitters has not, according to this specification, proved

Nº301,510

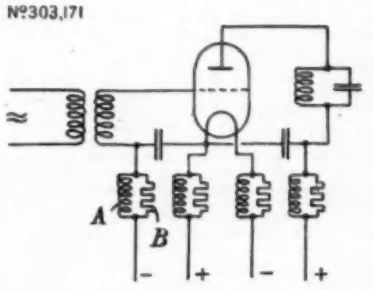


successful. The reason is that when the quartz crystal is more heavily loaded it is damaged on account of the potentials occurring at its electrodes. According to this invention two or more crystals A and B of the same natural frequency are used, and they are connected in series, thereby dividing up the potential E into values E_1 and E_2, which are applied to each individual crystal, these potentials E_1 and E_2 being the maximum potentials permissible for perfect operation.—*May 9th*, 1929.

303,171. December 28th, 1928.—CIRCUIT ARRANGEMENTS SUITABLE FOR USE IN VALVE TRANSMITTERS, Telefunken Gesellschaft für drahtlose Telegraphie m.b.H., of 12–13, Hallesches Ufer, Berlin, Germany.

It has been found that in valve transmitters cables and leads

Nº303,171



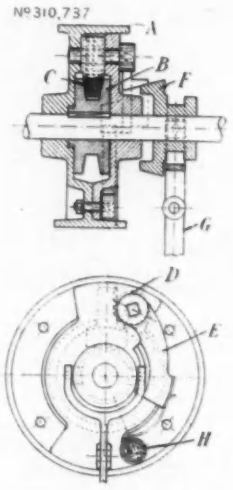
situated at operating points and carrying practically no high-frequency potentials at the working frequency may cause disturbing oscillations. These cables and leads easily oscillate and short waves are produced and cause disturbing oscillations

which may even damage the valves or other constructional elements. According to the invention, the production of oscillations in conductors which carry practically no high-frequency potentials at the working frequency is avoided by inserting a choke shunted by an ohmic resistance in the conductors. In the diagram chokes A are shown shunted by resistances B in the filament supply leads, in the anode supply lead, and in the grid bias lead.—*May 9th*, 1929.

TRANSMISSION OF POWER.

310,737. September 19th, 1928.—FRICTION CLUTCHES, J. Wilmotte, 4, rue St. Vincent, Liége, Belgium.

This clutch, it is suggested, is suitable for driving drop hammers or other services where rapid engagement is required. The pulley A is loose on the driving shaft, while the grooved

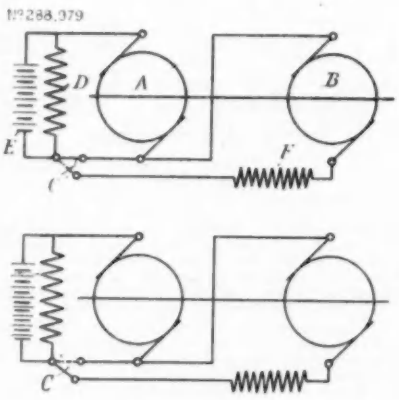


pulley B is keyed to the shaft. Engagement between the two parts is effected by the wedging shoe C, which is pressed into engagement by the rack and pinion D. The pinion is actuated by the lever E, which is engaged by the cone F. The clutch is engaged by pressing on the forked lever G and disengaged by the spring H.—*May 2nd*, 1929.

MOTOR CARS AND ROAD TRAFFIC.

288,979. April 14th, 1928.—ELECTROMAGNETIC TRANSMISSION GEARING, *Leonard Mellersh-Jackson, of Haseltine, Lake and Co.*, 28, *Southampton-buildings, Chancery-lane, London, W.C.* 2.

The electromagnetic transmission gearing described in this specification for motor vehicles consists of primary and secondary dynamo-electric machines A and B, the functions of which vary in accordance with the conditions of transmission. The field magnet of the primary machine A rotates with the driving shaft and the armatures of both machines are fitted on the driven shaft, the field magnet of the secondary machine being stationary, or, alternatively, in either machines, the positions of the relatively rotating members may be interchanged. At starting the primary machine acts as a generator supplying current to the secondary machine which works as a motor. As the driven shaft speeds up the relative speed of the primary field magnet and the armature is decreased and consequently the current supplied to the secondary machine diminishes. The power transmitted to the driven shaft by the secondary machine acting as a motor therefore decreases, but power is then also transmitted through the primary machine acting as an electromagnetic coupling, while at full speed the whole of the power is thus transmitted, the brushes of the primary machine being short-circuited. It has been proposed in such a system to provide a storage battery

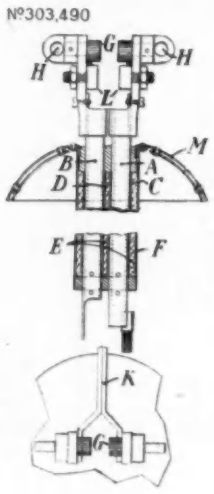


for lighting, excitation and other purposes, this battery being charged by the secondary machine when the gear is running at full speed and when this machine is not transmitting power. Under other conditions, however, when the secondary machine is transmitting a certain amount of power, excitation current is drawn from the battery and charging cannot take place. Consequently there is a risk of the battery becoming entirely discharged, making it impossible for the gear to operate, and it is one of the principal objects of the present invention to avoid this drawback. According to the invention, the battery is charged by slip current obtained from the primary machine when it is operating as an electromagnetic coupling. Thus it is possible to charge the battery while the gearing is being employed in such a manner that part of the power is being transmitted through the primary machine acting as a coupling and the remainder through the secondary machine operating as a motor. The connections shown are those which would be employed when the primary machine A is used purely as an electromagnetic coupling, the armature B of the secondary machine being cut out of circuit owing to the fact that the switch C occupies the position shown by the full line. In this position of the switch C the field winding D of the primary machine and the battery E are connected across the brushes of the armature A. When it is desired that the armatures A and B shall be placed in cascade the switch C is moved to the position shown in the lower diagram whereby the armatures are placed in series with each other and with the field windings D F of both machines. In either of these cases the battery E is fed by slip current from the primary machine A which operates wholly or partially as an electromagnetic coupling.—*May 9th*, 1929.

MACHINE TOOLS AND SHOP APPLIANCES.

303,490. July 26th, 1928.—ARC WELDING ELECTRODE HOLDERS, *Louis Renault, of* 8–10, *Avenue Emile Zola, Billancourt* (*Seine*), *France.*

The arc welding electrode holder described in this specification is for welding with three-phase current, and with electrodes of the sandwich type. The two conductors A and B for bringing current to the electrode are enclosed in mica tubes C and D, and in heat-insulating material E, and are enclosed in

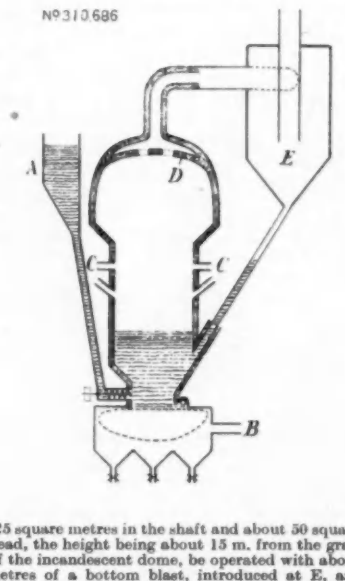


a tube of presspahn F, which constitutes the handle. This tube may be wrapped with a winding of string to improve the operator's grip. At G there are two excentrics, which can be adjusted by tommy bars passed through eyes H. The ends of the "sandwich" electrode K are placed in the gap between the stops L and the excentrics G. The handle is situated behind the protective shield M, through the walls of which air circulates.—*May 2nd*, 1929.

GAS PRODUCERS.

310,686. May 29th, 1928.—APPARATUS FOR THE MANUFACTURE OF FUEL GAS, *J. Y. Johnson*, 47, *Lincoln's Inn-fields, London.*

This producer is intended for working with brown coal. The coal is fed in from the hopper A, and a strong blast introduced at B. The coal is partly gasified, and acts, it is said, much like a boiling liquid. Secondary hot air is introduced at C C, and the gases produced escape through the incandescent refractory dome D. E is a dust catcher. If a producer having a sectional

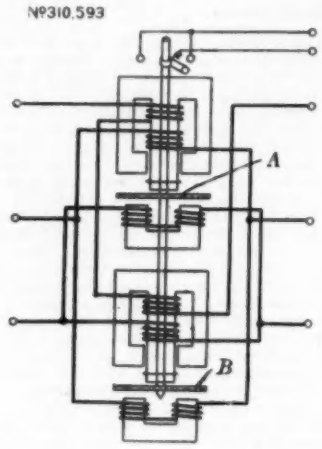


area of 25 square metres in the shaft and about 30 square metres in the head, the height being about 15 m. from the grate to the crown of the incandescent dome, be operated with about 20,000 cubic metres of a bottom blast, introduced at E, and about 50,000 cubic metres of a top blast, introduced at D, per hour, a gas will be obtained which contains 8 per cent. of CO_2, 21 per cent. of CO, 12 per cent. of H_2, 1·5 per cent. of CH_4, and 57·5 per cent. of N_2. The fine ash discharged from the producer contains 20 to 30 per cent. of coal.—*May 2nd*, 1929.

MISCELLANEOUS.

310,593. February 15th, 1928.—ELECTRICAL RELAYS, Thomas Wylie Ross, of 77, Cromwell-road, Stretford, Manchester, and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.

This invention relates to polyphase alternating current electrical relays of the kind which is responsive to change of phase sequence or unbalance of current in the several phases and has for its object to provide a relay of a substantial nature which is relatively stable in operation. A phase sequence and current balance relay constructed in accordance with the invention comprises two induction type alternating-current relay movements A and B combined to act upon a common rotary spindle, as shown, and each adapted to be energised in accordance with the current flowing in all the phases of a polyphase alternating-current system. When the currents traversing the three phases of the alternating current system are equal and in correct phase sequence, the torquec developed on the discs A and B are equal and opposite, and there is no tendency for the spindle to rotate. But if the currents in the three phases are unequal or



the phase sequence is incorrect the torques developed on the discs A and B are unequal and the spindle rotates, and the contacts shown at the top of the diagram close.—*May 21st*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Excavations at Ur, 1928-1929," by Mr. C. Leonard Woolley. 9 p.m.

TO-DAY TO THURSDAY, JUNE 13TH.

INSTITUTION OF GAS ENGINEERS.—Visit to Berlin for the meetings of the German Gas and Water Association, and to visit the German Gas and Water Exhibition.

TO-DAY TO SATURDAY, JUNE 15TH.

INTERNATIONAL FOUNDRY TRADES' EXHIBITION.—Royal Agricultural Hall, Islington, London, N. 1.

INTERNATIONAL HIGH TENSION CONFERENCE.—Paris. For provisional details see page 413, April 12th, 1929.

SATURDAY, JUNE 8TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—North-Eastern District Meeting at Gosforth. Meet at Council Chamber. Visits and paper by Mr. G. Nelson on "Municipal Works." 2.30 p.m.

WEDNESDAY, JUNE 12TH.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Visit to the North Wales Hydro-electric Power Station, Maentwrog.

THURSDAY, JUNE 13TH.

OPTICAL SOCIETY.—At the Imperial College of Science and Technology, Imperial Institute-road, South Kensington, S.W. 7. Experiments, Demonstrations and Exhibits, arranged by the Technical Optics Department of the Imperial College, with the kind permission of the Director, Professor A. O. Rankine, O.B.E., D.Sc. Exhibits of new Theodolites, by Messrs. Cooke, Troughton and Simms, Ltd.; Messrs. E. R. Watts and Son, Ltd. 6.30 to 10 p.m. 7.30, ordinary meeting. The following paper will be presented and discussed:—"The Beam Given by Dioptric Apparatus," by Dr. W. M. Hampton.

FRIDAY, JUNE 14TH.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, Westminster, S.W. 1. "Repairs to Diesel Engine Parts by Electro-deposition," by Mr. C. H. Faris.

MONDAY TO WEDNESDAY, JUNE 17TH, 18TH AND 19TH.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Summer meetings at Bath. *Monday*, Council Meeting at the Spa Hotel, 5.30 p.m. *Tuesday*, members assemble at the Spa Hotel, 9.45 a.m.; 10 a.m., special meeting, paper by Dr. Margaret Fishenden and Mr. A. F. Dufton, "Heating Research at Watford, 1928–1929"; 2.30 p.m., assemble in the Grand Pump Room for a visit to the Hot Mineral Baths; 7 p.m., reception in the Ball Room at the Spa Hotel; 7.30 p.m., banquet in the main Dining Room. *Wednesday*, 9.45 a.m., motor drive to Cheddar; 12.30 p.m., luncheon at the Cliff Hotel, Cheddar; 3 p.m. (prompt) leave Cheddar; return to London by the 6.21 p.m. train.

TUESDAY TO SATURDAY, JUNE 11TH TO 22ND.

INSTITUTION OF ELECTRICAL ENGINEERS.—France. Summer meeting. For programme see page 331, March 22nd, 1929.

TUESDAY TO FRIDAY, JUNE 25TH TO 28TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Manchester. Summer meeting. For programme see page 302, March 15th, 1929.

TUESDAY, JULY 2ND.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—Summer meeting. Visit to the Avonmouth Docks. Assemble main booking hall, G.W.R., Snow Hill, Birmingham. 11 a.m.

TUESDAY TO THURSDAY, JULY 2ND TO 4TH.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. Summer meeting in Newcastle-upon-Tyne, jointly with the Institution of Engineers and Shipbuilders in Scotland. "The Story of Safety at Sea," by Sir Westcott S. Abell; "Developments in the Uses of Electricity," by Mr. R. P. Sloan; "The Applications of Monel Metal in Engineering and Shipbuilding," by Mr. John Ireland; "Some Notes on Damage to Ships," by Mr. J. L. Adam.